LB 124 Scint
Digital Contamination Monitor

ID No.: 43727BA2
Rev. No.: 06 09.04.08

Contents

How to Work with this Manual

A brief overview of the structure of the present operating manual will help you to find the pertinent information quickly and easily:

Chapter 1 provides basic information on the principle of operation of the digital contamination monitor: How does a scintillation counter work? What is the significance of the units cps and Bq/cm²?

Chapter 2 contains the description of the monitor:
The construction of the device, including operating and display elements, the functions of the keys, as well as the assembling and handling of the detector.

Chapter 3 describes how to take the LB 124 Scint into operation.

Chapter 4 describes the software structure and operation.

Chapter 5 provides information on the contamination measurement: measurement conditions, measuring process and explanations of the individual measuring methods.

Chapter 6 documents all software functions of the LB 124 Scint on the System Menu. This is the reference part of the operating manual.

Chapter 7 contains the description of the maintenance work required.

Chapter 8 deals with the calculation methods used by the LB 124 Scint, and the statistical measuring accuracy.
Moreover, the chapter describes how to convert the unit of measurement from counts per second into surface activities, so that you are able to determine your own calibration factors with the help of the given formula and by means of a calibrating source, and to enter this data in the LB 124 Scint.

Chapter 9 contains the technical specifications.

Safety instructions

Use and function

The digital contamination monitor LB 124 Scint can be widely and flexibly used for contamination measurements in radiation protection.
It is used wherever contamination caused by radioactive substances is encountered and has to be monitored:
in medical nuclide laboratories, in nuclear research, in nuclear power plants, as well as the environment in general.

Safety instructions

If official regulations exist concerning the installation and/or operation of radiation measurement devices, the operator must ensure that these regulations are complied with.
The manufacturer has undertaken everything to ensure the safe operation of the instrument. The user has to make sure to use and handle the LB 124 Scint in such a manner that the safe operation is not endangered.
In particular, this applies to:

The sensitive window foil of the counter tubes:

- Whenever you are measuring uneven or pointed objects, be careful not to damage the foil.

To be able to handle the monitor LB 124 Scint properly and according to its intended use, one has to have a thorough knowledge of the operating manual. Although the handling is very easy, you should nevertheless read the manual.

In order to make sure that the device works properly, please follow the manufacturer's instructions concerning the functional checks and maintenance work.
All maintenance and repair work exceeding the steps described in the operating manual must only be carried out by BERTHOLD TECHNOLOGIES or else by technicians authorized by BERTHOLD TECHNOLOGIES.

1. The Principle of Operation of the LB 124 Scint

1.1 Overview

The portable contamination monitor LB 124 Scint is used for detecting and measuring radioactive alpha, beta and gamma contamination on various surfaces such as floors, walls, desks, objects, clothes or the skin. It consists of a display unit with microprocessor electronics, the photomultiplier, and a ZnS scintillation counter with an effective window size of 118 mm x 145 mm, which can easily be replaced, and which is inserted in the bottom of the instrument.
The LB 124 Scint is able to distinguish alpha nuclides from beta/gamma nuclides and measure them simultaneously.

The data can alternatively be displayed as count rate (cps = counts per second) or as area activity (Bq/cm²).
The device is protected as much as possible against environmental conditions such as humidity, dust or extreme temperatures, and is therefore also suited for outdoor use and rough operating conditions. The entrance window of the detector is protected against damage by a metal grid.

Since not only professionals will work with the Contamination Monitor, we would like to give you some quick information on the working method of scintillators and on how to perform radioactivity measurements.

1.2 The Principle of Operation of Scintillation Counters

With conventional scintillation counters the radiation to be measured hits one or several scintillator layers. The flashes of light which are created in this process are propagated – either directly, or bundled by a suitable reflector – to a photomultiplier and measured.

Former state of the art

To be able to measure alpha as well as beta and gamma radiation, so-called sandwich detectors have been used which comprise two layers: ZnS for the alpha radiation and plastic scintillators for the beta and gamma radiation, with the ZnS layer facing the sample.

The drawbacks of this method are the low sensitivity to the low-energetic beta radiation, which has to pass through the ZnS layer, and inadequate discrimination of the radiation types (strong spillover effects in the beta channel) as well high production costs.

New measuring method by BERTHOLD TECHNOLOGIES

The Contamination Monitor LB 124 Scint is using a single scintillator made of zinc sulphide (ZnS) to measure radioactivity. The radiation to be measured hits the scintillator. The flashes of light created in this process are passed to a photomultiplier via a suitable reflector with suitable preamplifier and discriminator stage and measured. The individual types of radiation, i.e. **alpha and beta, gamma, X-ray radiation**, can be distinguished by means of special evaluation and correlation circuits, and thus separated and measured at the same time. The spillover of alpha particles into the beta channel is corrected by the software, so that only the beta-gamma parts of the alpha sources, i.e. Am-241, will be indicated in the beta channel.

The benefits of this method are:

- high measurement accuracy
- exact distinction of the types of radiation and the individual nuclides (very low spillover)
- high sensitivity even at low energies
- the negligible spillover of Alphas into the Beta channel
- low costs for the scintillator and
- ease of maintenance.

1.3 What's Being Measured?

a) Counts per second (cps)
The Contamination Monitor is used to measure the radiation activity on the surface of persons or objects in counts per second. With this measuring method, all alpha, beta and gamma counts are then counted and displayed every second (cps). Since the count rate registered each second is subject to statistical variations, the average is calculated on a continuous basis, so that the displayed result is adapted to the count rate and the displayed results is less and less subject to statistical variations after a very short measuring time.

b) Area activity (Bq/cm^2)
When you choose to measure the contamination in Bq/cm^2 (i.e. the radiation area activity), the count rate has to be converted into surface activity. There is a different conversion factor for each nuclide. The individual factors are stored in the LB 124 Scint. It is therefore necessary to select the nuclide or nuclide compound to be measured at the device before each measurement. An alpha nuclide can be set for the alpha channel and a nuclide with beta or gamma radiation can be set for the beta-gamma channel. The types of radiation are distinguished during measurement. The measurement takes place simultaneously.

This does not mean, however, that the contamination monitor is able to measure this particular nuclide selectively; but the monitor just values the contamination (i.e. the count rate measured) as if it was caused by the respective radio nuclide.

The conversion is based upon calibration factors determined for each nuclide and for your monitor. They do not only depend on the

- radiation type,
- radiation energy and
- decay scheme of the respective nuclide;

but other factors are of importance as well, such as the:

- detector sensitivity,
- measuring geometry,
- self-absorption in the calibrating source.

The calibration factor thus indicates the value with which the counts per seconds have to be multiplied to obtain a result display in Bq/cm^2.

Accordingly, a measurement in Bq/cm^2 is only correct if the selected nuclide and the measured nuclide are one and the same.

When you select the unit Bq/cm^2 and the respective nuclide, the LB 124 Scint automatically converts the cps measured into Bq/cm^2. To measure the area activity, the software comprises an (editable) nuclide library containing at present approx. 60 different nuclides and the respective calibration factors. Moreover, two free entry positions are available, where you can enter e.g. calibration factors for other nuclides.

What can you do if you don't know the nuclide?

As things are not always that clear in practical operation, but you are often dealing with nuclide compounds, unknown or only partly known nuclides, the following solutions are at your disposal:

Determine an unknown nuclide

An unknown nuclide can be determined by means of a half-life measurement. Proceed as follows: On the **Measurement** menu, select the item **Half-life Value** (see chapter 6.4.5).

Nuclide compound of unknown composition

When you are dealing with unknown compositions, you can select a calibration factor representing an average value of the most frequently occurring beta radiation sources after nuclear power station accidents.
When the nuclides are not known, please select the option **β-Tot** (Beta total).

Nuclide compound of known composition

If you wish to measure the activities of several nuclides that are known to you at the same time, you can do the averaging yourself (and also the weighting, if required), and then enter the calibration factor. The free entry positions that are at your disposal for this purpose are dealt with in chapter 6.6.

Another possibility is to preset a so-called radioactive tracer. This means that you select one of the isotopes stored in the nuclide library of your device; this isotope should be one of average energy and should correspond with the nuclide compound to be measured.

1.4 Measurement Modes

The LB 124 Scint offers the following measurement modes:

a) **Survey mode** for fast detection of contaminations. In this mode the instrument reacts very sensitive to different types of radiation activities and shows changes very quickly.

b) The **Ratemeter mode** does not react quite as quickly to activity differences, but a higher accuracy can be achieved.

c) The **Scaler-Timer mode** is designed for high measuring accuracy. Here you can choose between two standards for the length of a measurement: the measuring interval and the statistical accuracy

d) For a **clearance measurement**, a limit value is defined and if this value is exceeded, a signal will be triggered.

e) The **half-life measurement** is used to determine the nuclide.

Alarm thresholds

One alarm threshold can be defined for each nuclide; if this threshold is exceeded, an optical and acoustic signal will be actuated.

Storing measured values

Up to 1000 individual measured values on average can be stored and transferred to a PC or printer. The respective relevant parameters are stored together with the measured values. These parameters depend on the measurement mode.

Measuring accuracy

With both measuring methods (count rate and decay rate), you can use either the survey or ratemeter function (quick measurement function), or the scaler-timer function. In the ratemeter mode the measuring accuracy can be estimated based on the display accuracy (few or no decimals). Up to 3 decimals are displayed.

Range of application of the ratemeter, scaler-timer and survey modes

Measurements in the operating modes "**Survey**" and "**Ratemeter**" are used to detect contaminations. In this mode, every change in the radiation field is quickly indicated. In the **Survey mode** a lower measurement accuracy is accepted in order to detect changes even more quickly.

An *accurate measurement* requires - in contrast to the *Survey mode* - averaging of the count rates over a *longer period of time*. The LB 124 Scint does this automatically in the **Ratemeter mode**, provided that the mean count rate remains constant within the statistical significance range during this period. This can for example be assumed for a contamination measurement, if the device is not moved during measurement.

To carry out stationary measurements with a given *accuracy for the average value*, however, it is advisable to select the operating mode ***Scaler-Timer***. In this measurement mode, you can preset either the *averaging interval* or – by selecting the number of pulses per unit time – the *statistical accuracy* of the measured value.

For great demands concerning the accuracy, you are also able to determine the background (immediately before the actual measurement) in the CPS (raw data) mode by means of the scaler-timer, and to enter this background value immediately.

2. System Description

2.1 Housing with Electronic System

The splash-proof housing accommodates the measuring and control electronics, the software and the operating elements of the monitor (see Figure 1).

Figure 1: LB 124 Scint

Electronics

The complete **electronic system with photomultiplier** (incl. the software and the high voltage generator) is located inside the housing.

Scintillator

The scintillator is deposited on a transparent carrier. The foil is stretched over a frame and protected by a metal grid. The detector is fixed to the bottom side of the device with two fixing screws that it can easily be unscrewed with the help of a coin. The frame with foil and scintillator can easily be exchanged.
Make sure to change the frame in semi-darkness, as the photomultiplier and scintillator are sensitive to light. Then do not work with the device for 12 hours to allow the phosphorescence radiation to subside.

Protection plate

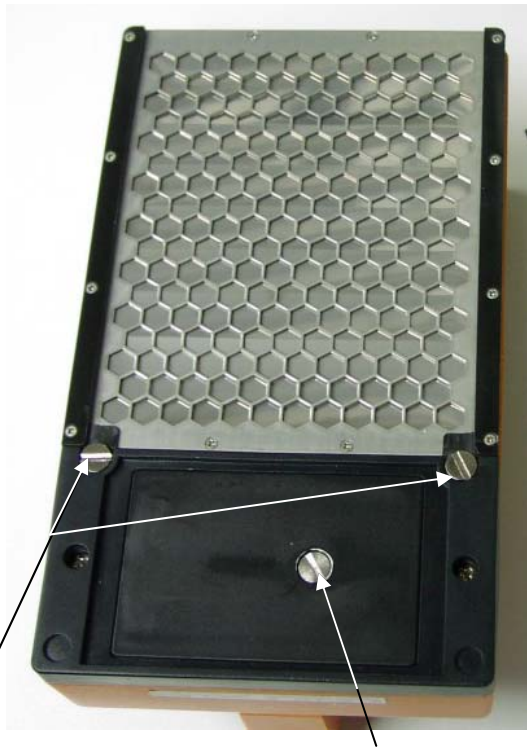
The radiation entrance window can be protected by a metal protection plate.

Connections

The **connections** for the **power supply unit** and the **PC/printer** (RS232 interface) are located on the right side of the device.

Operating voltage

The device can be operated either with the help of a **power supply unit**, with **rechargeable batteries** (baby 1.2 V), or with **batteries** (baby 1.5V) located on the bottom side of the device (see). When the power supply unit is connected, the operating voltage is supplied via mains and the rechargeable batteries can be charged. The charging process is started via the menu **Power Supply**/**Charge Mode**. During the charging process, the device works with mains voltage.
If the LB 124 Scint is connected to power or placed into the charging station, the device is turned on automatically.



Fixing screws for counter tube Fixing screw for battery case

Figure 2: Contamination Monitor (view from below)

2.2 Operating and Display Elements

Measurement, operation and display are controlled by the software integrated in the LB 124 Scint. Measured values, menus and user information are displayed on a monochrome LCD graphics module (192 x 64 pixel) with LED backlighting and a scratch resistant Plexiglas screen. The operation takes place with the help of the six function keys below the screen. Alerts and status signals are output via 2 LED's and a buzzer.

2.2.1 Design of the Display

Measurement menu

For more detailed information, please refer to chapter 4.2

Top line (black shading):
Shows status information and the profile name (user).

Center field:
Net measured value(s) with unit of measurement and measured nuclide(s) or the net value (= cps measurement). In case of simultaneous α-/$\beta\gamma$-measurement, both measurement values will be displayed. Below these values, you find information on the measurement which can be selected via the softkey function **Info/Mod**: e.g. the gross values or the representation in the form of a **scale** from 0-100% in proportion to the alarm threshold of the selected nuclide.

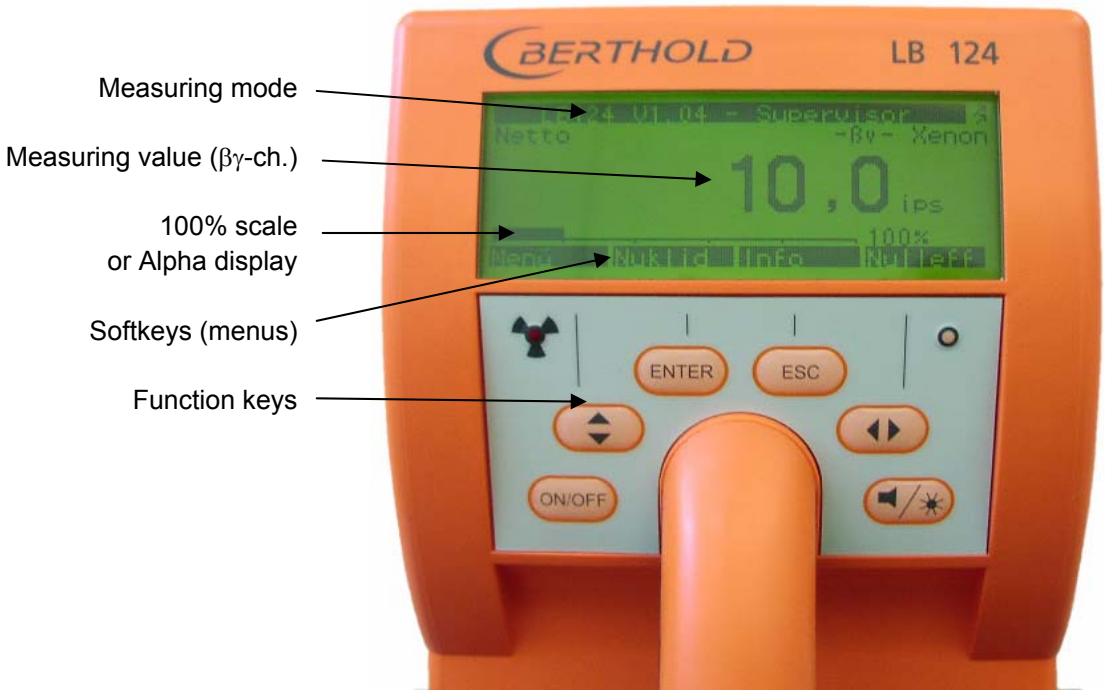
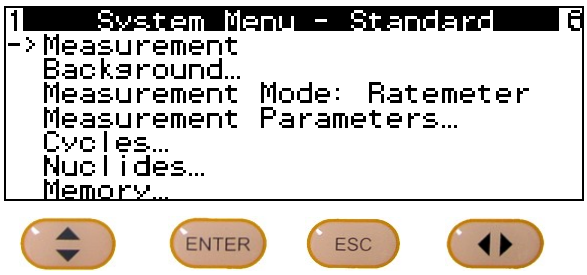


Figure 3: Display and function keys

Bottom line (black shading):
Here the menus or functions are displayed that can be selected via the keys under the display (so-called softkey functions. Softkey functions). On the Measurement Menu, the four function keys in the center have the significance that is assigned to them via the softkeys above.

System menu

On the **System Menu**, the menus and functions that can be selected are displayed, and parameters can be edited.
The selection and the parameter input takes place via the push keys. The functions of the individual push keys can be seen from their respective labels. See chapter 4.1.



Softkey buttons

2.2.2 Function Keys

The operation of the device and the software takes place via six push keys with the respective function names. The 4 keys in the middle have additional functions on the Measurement Menu; these functions are assigned to them via the softkeys above them (this is made clear by means of the vertical lines). The softkeys are indicated in the bottom line of the display (black shading). See chapter 4.2.

2.2.3 Alerts

LED displays
Left LED
Right LED

The LED's on the foil keyboard indicate the following states:
Alert: the threshold has been exceeded
When a button has been pressed, this LED is lit as long as the processor is busy with the actuated function.

Acoustic signal

When the threshold is exceeded, an alarm signal sounds (if set on the **Parameter** menu). The red LED (on the left) is flashing. On the **Parameter** menu you can choose **visual**, **acoustic** or **vibration** as signal type.

Battery exchange

When the battery/rechargeable battery voltage indicated after power on of the device is below 3V for batteries and below 3.5V

for rechargeable batteries, the running time left is max. 2-4 hours!

In this case, the batteries have to be replaced.

2.3 Scintillation Counter

The scintillator is deposited on a transparent carrier. The foil is stretched over a frame and protected by a metal grid. The detector is fixed to the bottom side of the device with two fixing screws that can easily be unscrewed with the help of a coin. The frame with foil and scintillator can easily be exchanged.
The reflector and the photomultiplier are located inside the housing, directly behind the scintillator. Also inside the housing there is the power supply, the electronics with evaluation and correlation circuits as well as the evaluation electronics with the software.

The high voltage is factory-set. The high voltage can only be checked or modified with the help of a service adapter and by experienced maintenance personnel.

The scintillator which has been deposited on the foil, can easily be exchanged without having to use any special tool, e.g. if the foil is damaged (see chapter 7.2).

When you replace the foil, please make sure that

- ❑ the replacement takes place in a dry and dust free place
- ❑ no humidity or dirt whatsoever can get into the gap!
- ❑ you change the frame in semi-darkness, as the photomultiplier and scintillator are sensitive to light. Then do not work with the device for 12 hours to allow the phosphorescence radiation to subside.

2.4 Power Supply

2.4.1 Batteries

The fixing screw of the battery case cover can be unscrewed using a coin, so that the cover can be taken off.

Figure 4: Open battery case

Using batteries

The device can be run with 3 batteries (baby 1.5V).

To ensure the correct arrangement of the batteries, their respective polarities are indicated at the bottom of the battery compartment (see Figure 4).

Any time the device is started up, the user is informed about the state of the batteries: The voltage can be queried on the menu **Parameter/Power Supply/Voltage Battery**.
For this purpose, **Battery** has to be selected as software setting on the **Hardware** menu.

Please note:
The RAM memory storing the measured data, the settings and the date is permanently supplied with power via a lithium battery when the device is not being run with supply voltage or with batteries/rechargeable batteries. In order to avoid a data loss, the lithium battery should therefore be replaced while the device is being supplied with power with supply voltage or via batteries/rechargeable batteries. The lithium battery is located on the motherboard and should therefore only be replaced by trained staff.

2.4.2 Rechargeable Batteries and Power Supply Unit

When an accumulator is used for the power supply, the option **Accu** on the menu **Parameter/Power Supply** has to be selected. With this option, the **Charge Function** is activated when the charging mode is set to **ON**. Do not enable the charging function if batteries are in the device.
If the LB 124 Scint is connected to power or placed into the charging station, the device is turned on automatically. The charging process is started new depending on the settings for cell type, charge mode and charge time. The charging process takes place only when the device is turned on.
An activated **System Timeout** is not taken into account while the charging function is active.

2.4.3 Power Supply of the Photomultiplier (PM)

Batteries and rechargeable batteries do not only supply the basic device with power. Using a fixed control voltage between 0.5 and 1.3 Volt, the high voltage of the photomultiplier is controlled.

2.4.4 Power Supply and Program Memory

1. The software program, the calibration factors as well as all fixed settings are stored in the FLASH and are independent of the power supply.
2. The calibration factors, threshold settings, dates, measured values, etc. defined by the user are stored in the RAM (lithium battery-buffered). By means of the reset function (the factory settings can be found under parameters/factory settings), these values can be deleted; in this case, the factory-set default values will be loaded. This function is only accessible if the respective authorization to access has been assigned.

2.5 Data Interface

Data is output to a PC or printer via the RS 232 data interface (see Figure 1).

Software for data transfer to PC

Data transfer between the LB 124 Scint and a PC is at present only possible in one direction, i.e. when the respective output function is activated (e.g. output of stored measured values or through cyclical printout), the data is output via the interface. In order to receive the data, a standard terminal program has to be installed on the PC. The terminal program integrated in *Windows* has been tested by the manufacturer.
For correct data transfer, it is necessary to adapt the transmission parameters in the terminal program to the parameters of the output device. The LB 124 Scint issues 8 data bits, no parity and one stop bit. The transfer rate (baud rate) can be modified on the menu **Parameter / RS232**. The default setting of the device delivered is 19200 baud. When you start a printout of the measured values, these have to be readable in plain text on the screen. The file generated during this procedure can be further processed with any standard ASCII editor, or else transferred to a printer. The data (separated by Tab and CR/LF) can be processed further using a spreadsheet program such as EXCEL.

2.6 Equipment Delivered

Standard equipment

The measuring and display unit LB 124 Scint with ZnS scintillation counter.

Standard accessories

1 set of spare batteries
Operating manual

Optional accessories

1 plate with a test source with ^{90}Sr
1 aluminum transport box, 40 cm x 26 cm x 25 cm.
1 power supply unit
1 wall bracket

3. Getting Started

3.1 Connecting the Device

(a) Battery compartment

(b) Battery arrangement

(c) Mains connection

(d) Removing the transportation lock

- ❑ Carefully unpack the device.
- ❑ Connect the device to the power supply. It can be run with batteries (baby 1.5 V, ID08932) or rechargeable batteries (baby 1.2 V, ID38396), or using a power supply unit (ID36116):
- ❑ Battery operation: Unscrew the fixing screw of the battery case on the underside of the device. See **(a)**.
- ❑ Place the batteries in the battery case following the instructions on the bottom of the battery case. See **(b)**.
- ❑ Mains operation: Put the cable of the power supply unit in the correct socket on the right side of the device, then fix it with the screwed plug. See **(c)**. Connect the power supply unit to the **mains socket**. **The device will be turned on automatically.**
- ❑ Remove the transport protection from the entrance window of the detector on the underside of the device by sliding out the black metal plate. See **(d)**. Keep the plate as transport protection against damage of the window foil for future transports.
- ❑ Turn on the device by pressing the ON/OFF button.
- ❑ After power on, the device first displays the software version, the battery/accu voltage, the free memory and the date for 3 seconds, then it switches directly to the ratemeter measurement mode (cps) and can be used immediately. The measured values of both measurement channels (beta-gamma and alpha-channel) are displayed. To change the measured value display, please see chapter 4.2. After the first start-up, the device is in the **Standard** profile with possibly restricted access rights. If you wish to define further profiles with different rights, refer to chapter 6.9.

Figure 5: Measured value indication after start-up.

Please note: After each start-up, the device is in the same profile it was in before being switched off. If required, select your own profile from the profile menu. See chapter 6.9.

3.2 The First Control Measurement

- ❑ Turn on the device by pressing the **ON/OFF** button. When started the device first displays the software version and the battery voltage and switches then to the ratemeter measurement mode (cps) after start-up and can immediately be used.
- ❑ Slide the metal plate with the test source Sr-90 on the counter tube.
- ❑ After a measuring period of approximately 10 seconds, read the determined measured value and compare it to the value indicated on the test source. Your measured value should reach this value with a tolerance of +/- 10% after approx. 10 seconds.

3.3 Setting Basic Parameters

Before starting to measure, the most important parameters have to be set and the factory-set parameters (alert thresholds, background etc.) have to be modified according to your specific requirements and conditions.
The following parameters should be checked or modified:

- ❑ Define the **Language**. See chapter 6.8.1.
- ❑ Enter the **Date/Time**. This is important for your documentation. Each measurement stored is provided with the respective date and time. See chapter 6.8.2.
- ❑ Define the parameters for the individual measurement modes and measuring channels on the menu **Measurement Parameters.** See chapter 6.4.
- ❑ If required, define the **Calibration Factors** for additional nuclides or nuclide compounds (use the positions B-1 and B-2) and define nuclide-specific alert thresholds, if required. See chapter 6.6. The calibration factors can be changed in the Expert profile; therefore, select this profile (chapter 6.9).
- ❑ **Select nuclides** for measurements. In order to be able to select the nuclides required for a current measurement directly, you should pre-select the respective nuclides for the small nuclide table of the Measurement Menu. See chapter 6.6.

- ❑ Carry out a **Background Measurement**. The background is subtracted from each measurement. This value should correspond with your ambience conditions and should be checked and updated regularly (at least once a week). See chapters 5.1.2 and 6.2.
- ❑ Battery operation: Set the **System Timeout** (automatic switch-off when the device is not used). See chapter 6.8.5.
- ❑ If necessary change the profiles EASY and STANDARD as needed. If necessary, define a new profile.

3.4 Possible Errors During Start-Up

The following errors or error messages may be encountered during start-up

Error (message)	*Error cause / trouble-shooting*
No reading on display	The batteries are dead. Replace them. No power supply present. Check connection cable.
Nominal count rate of test source is not reached or Background count rate is too low. or Displayed count rate is ”**0.0 CPS** ”	Check detector for tightness An intact detector has a plain, stretched and level foil. A slack, wrinkly foil means that the detector may be damaged; replace the foil The high voltage part of the detector is probably defective. If the HV-part is defective, the detector has to be replaced. The background that has been set is too high. To check this, push the Info button to display the raw data. Check internal connection electronics <--> probe
INV	Count rate in the alpha channel is > 750 cps. Above this count rate, no meaningful measurement is possible any more in the beta channel.
OVF	Count rate in the alpha channel > 5 000 cps or count rate in the beta channel > 50 000 cps.
„Entrance window broken or α-rate out of range. Please switch off!“	High α-count rate present or foil defective. Very small holes can be closed by a light-tight tape.

4. Software Design and Operation

4.1 Software Structure

System menu

The software of the LB 124 Scint has a menu-based user interface. All functions (parameter definition, measurement etc.) are selected from the **System Menu** (see Figure 6).

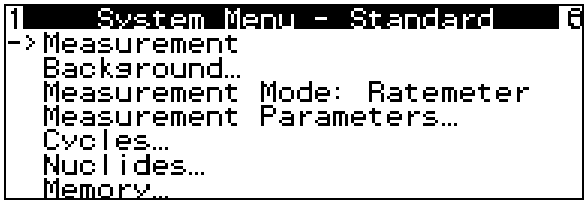


Figure 6: System menu

Menu or option names with several periods (…) at the end indicate that there is another display linked to it.
Menu items with an additional setting (e.g. **Measurement Mode**) allow the setting to be modified directly: move the cursor to the respective menu item and press the ENTER key. Then the setting can be modified with the key.
Options without periods are commands that are immediately executed when selected (e.g. **Measurement** on the **System Menu**.
To select a menu or an option, move the cursor to the respective menu item and press the ENTER key.

Measurement menu

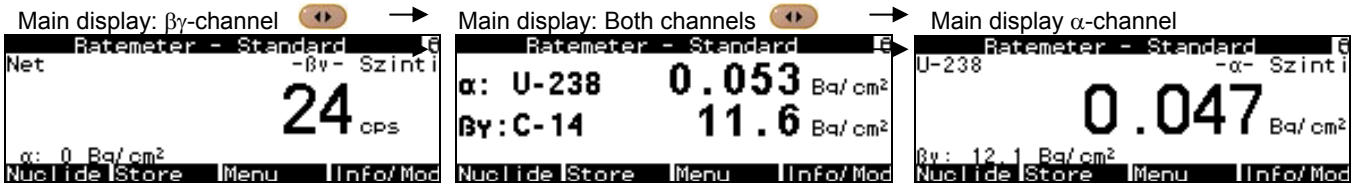
You get to the **Measurement Menu**
a) directly after turning on the device or
b) by selecting **Measurement** on the **System Menu**.
c) by pressing ESC on the **System Menu**.

Figure 7: *Measurement menu (structure of display see ch. 4.2)*

4.2 Measurement Menu Display

The type of radiation which has been set when quitting the Measurement menu is displayed first. Then you can choose if both types of radiation are to be displayed at the same time or which type of radiation (measurement channel) is to appear as main display. The other measurement channel is displayed in the info line.
To toggle between the various display modes of the measured values, keep the button (**Info/Mod** softkey) **pushed down until a small clock appears in the top left corner of the display (after approx. 1 second)**.
In each of the three display modes you can view additional information on the main display by **briefly pressing** the (**Info/Mod**) button.

Main display: βγ-channel → Main display: Both channels → Main display α-channel



Top line of display
Shows the measurement mode (Ratemeter, scaler/timer...) or **Date** (after power on) or **Status** (Buzzer / Light) or the line number (only if > 1 page and on the **Memory** menu) and **Profile** (User)

Second line (only for 1 channel)
Left: **Nuclide** or **Net/Gross**
Right: **Type of radiation**

Center
Net/gross results during the measurement (in [cps], [Bq/cm^2] or [Bq/l] in dependence on the selected nuclide(s)) or **final result** of the measurement (mean value, clearance/contaminated, half-life value, minimum/maximum ...)

Info line, second line from the bottom
Scroll with
Measured value of 2nd measurement channel, bar graph, accuracy, calibration factor, date and time, background with measurement time, minimum and maximum value, raw data value, gross count rate, selectable by repeatedly pushing (briefly) the (**Info** softkey).
Some info lines are not available on the main display: **Both channels**.

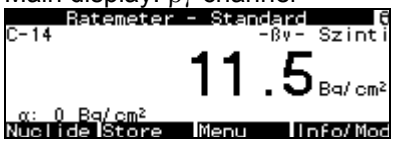
Bottom line
Shows the softkey function depending on the selected mode.

Counter/Timer:	*During measurement*: **Nuclide**, **Stop**, **Info/Mod**
	After complete measurement: **Store**, **Start**, **Menu**, **Info/Mod**
Ratemeter:	*During measurement*: **Nuclide**, **Store**, **Menu**, **Info/Mod**
Survey:	*During measurement*: **Nuclide**, **Store**, **Menu**, **Info/Mod**
Clearance:	*During measurement*: **Nuclide**, **Stop**, **Info/Mod**
	After complete measurement: **Start**, **Menu**, **Info**
Half-life	*During measurement*: Save, **Stop**, **Info/Mod**
	After complete measurement: **Start**, **Menu**

Softkey function **Info/Mod**
During measurement the information mentioned above can be displayed by repeatedly pushing the button (briefly). Push this button for a longer time to select another type of radiation.

Softkey function **Nuclide**
During measurement, the information described below can be called by repeatedly pressing the button (separated by type of radiation):

Info/Mod Repeatedly pushing this button for a short time shows additional information on the on-going measurement. Even after completion of the measurement, further information can still be viewed if you are working with scaler-timer, clearance and background measurements).
Depending on the measurement mode, the following additional information is displayed:

Main display: βγ-channel		Main display: α-channel
	Additional display of **measured value of the 2nd channel** (here alpha channel)	
	**%-scale**. This bar chart shows the ratio between the respective measured values and a set threshold value. Indication in percent of the threshold value. If the threshold is exceeded, the left LED is flashing and an acoustic alarm is triggered – if preset. The respective multiplication factor is indicated next to the graph: x10; x100; x10x100.	
	**Accuracy** of 1st measurement channel	
	**Threshold value and calibration factor** of 1st measurement channel	
	**Date and time**	
	**Background** which is subtracted, and the **measurement time** used for measuring the background.	
	**Minimum and maximum value** of the current measurement in the 1st measurement channel.	
	**Gross measured value**	

In case of a simultaneous α-/βγ-measurement, only the current accuracy for both channels and date/time are displayed.

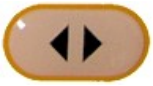
4.3 Key Functions

If you push a button for a longer time, a clock symbol appears in the upper left corner of the display. You may release the button as soon as the symbol appears.
The software is operated by means of the 4 push buttons in the center below the display. They have the following double functional levels:

a) On the **System Menu**, the key function can be seen from the button label
b) On the **Measurement Menu**, **softkeys** (menu options) are displayed in the bottom line which assign their respective function to the key underneath. Pressing the key selects the corresponding option.

4.3.1 Push Buttons

The button label reflects the function. If no softkeys are displayed, the six buttons have the following function:

	**Turning the device on/off**. The key has to be pressed for approx. 0.5 seconds to turn the device on, and for at least 1 second to turn it off.
	**Move the cursor (→) up or down**. Press this button to move **the cursor (→) up or down** in a select list (menu, parameter, numbers, letters). You navigate to the bottom by pressing for a short time, or to the top by pressing longer (>1 sec.).
	**Selection of a menu item** or **confirmation of the input** as well as **start of a measurement**. With some functions, there is the possibility to follow a direct link to the settings by pressing the button a little longer.
	**Input cancelled** without storage. **You quit the menu**.
	When entering numbers or letters: **Moving the cursor** to the right (press for a short time) or to the left (press longer >1 sec.) In the nuclide table: **Turning pages** (forward by pressing the button for a short time, backward by pressing it longer).
	**Turning on/off the buzzer** and the **LCD-lighting** as well as **adjusting the display contrast** (keep the button pressed until the desired value has been reached). The current state is indicated in the top line of the display. LCD lighting enabled: The background lighting goes off automatically if no button is pushed for 60 seconds. It comes on again as soon as a button is pushed.

4.3.2 Softkeys

On the **Measurement Menu**, the software is controlled with the help of so-called softkeys. Softkeys are software-controlled key designations on the display, which assign the current functions to the push keys. They are displayed in the bottom line.

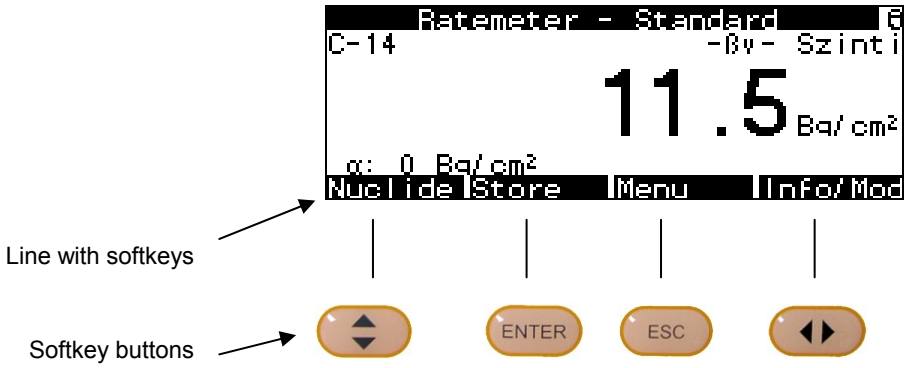


*Figure 8: The items **Nuclide**, **Store, Menu** and **Info/Mod** are selected by pressing the corresponding button beneath them.*

Explanation of the example in Figure 8:

By pressing the ESC key, you call the **System Menu** where you can select the individual menus.

By repeatedly pressing the key, you pass through the small nuclide table (see chapter 6.6) and have the possibility to set the desired nuclide of the displayed type of radiation for the current measurement. If the display does not switch to a different nuclide when you press the key, there are no further nuclides defined.

By pressing the ENTER key, the measurement is stored.

By pressing the key, you are able to demand information about the measurement: raw data values, bar graphs etc.

If you push the button for a longer time, the presentation of the measured values of the measurement channels will change.

4.4 Operation

4.4.1 Selecting Menus and Options

Move the cursor (→) on the **System Menu** to the desired menu or option by pressing the key, then press ENTER. The respective menu item is activated and the corresponding page is displayed.

4.4.2 Editing: Entering Numbers and Letters

- ❑ Move the cursor (→) to the desired parameter by pressing the Then press ENTER. This activates the edit mode for the respective parameter and the first input place is marked by the cursor ■.

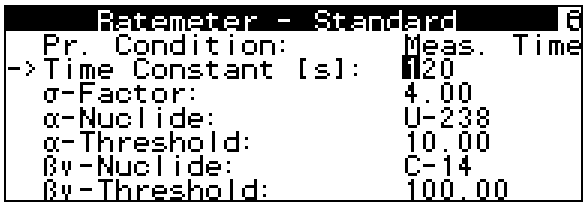


Figure 9: Selecting a parameter

- ❑ If you wish to make a new input, begin here. If you wish to overwrite an existing number, move the cursor ■ to the respective number.
- ❑ Then select the desired number by repeatedly pressing the key.
- ❑ To enter the second place, press the , and key, and then choose the desired number by repeatedly pressing the key.
- ❑ Proceed in the same way for all places of the desired number.
- ❑ When all places of the number have been entered, confirm the input with ENTER.

Letters are entered in the same way (01234567890abc...z).

4.4.3 Selecting Items from a List

Proceed as follows if you can only select predefined values or categories from a list:

- ❑ Mark the parameter using the cursor.
- ❑ Press the ENTER key. The edit mode is activated. By repeatedly pressing , the available options are displayed one by one.
- ❑ Confirm the desired option with ENTER. The selection is accepted.

Examples:

Setting the **Measurement Mode**
Ratemeter
Scaler-Timer
Survey
Survey
Half-life
Sandwich

Measuring settings for ratemeter measurements:
Preset Condition
Preset Time
Precision

4.4.4 How to Switch to the System Menu?

After power on

- When the device has been switched on, it goes automatically into the measurement mode, which was set when switching off the device (Measurement Menu).
- In the ratemeter mode: Choose the option **Menu** by pressing the ESC key. Then you get to the **System Menu**.
- In the scaler-timer mode: Stop the current measurement by pressing ENTER. Then the softkey **Menu** appears. Press then the associated ESC key.

During parameter input

- Quit the edit mode by pressing ENTER or ESC.
- Press again ESC. This brings you to the next higher level in the menu structure, until you get to the **System Menu**.

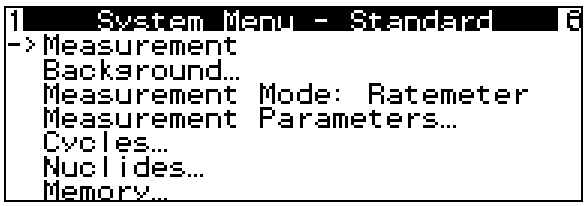


Figure 10: System menu with menu items

4.4.5 LED Indicators

The two LED's on the foil keyboard indicate different states:

Left LED: Alert in case of exceeded threshold

Right LED: When you press a key, this LED will be lit as long as the processor is busy with the execution of the activated function.

5. Contamination Measurements

You can start with the contamination measurements immediately after the initial start-up of the device. When it is turned on, the device immediately starts measuring and displays the results according to the preset nuclide and measurement mode or the background measurement (in case of preselected autostart function)
Explanations concerning the setting of the parameters and the application of the different measurement modes can be found in chapter 6.3.

Please note that the following three operations have to be performed in order to guarantee adequate contamination measurements:

1. After the first start-up of the monitor and later at regular intervals, a functional check should be performed to make sure that the device works properly. This is also prescribed in § 67 of the German Radiation Protection Act.

2. Normally, you will first measure the activity caused by the ambient radiation (= background) to get the pure surface radiation (chapter 5.1.2). During each measurement, this stored background value is automatically subtracted.

3. Nuclide-specific alert thresholds are entered for the radiation to be measured; when these thresholds are exceeded, an acoustic and optical signal is actuated (chapters 5.1.3 and 6.6).

In case that you have already performed these steps, please go on to chapter 5.2.

5.1 Contamination Measurement Requirements

5.1.1 Performance Check

- ❑ Turn on the device and make sure that the battery capacity is sufficient.

  Warning signals:
  When, after switching on the device, the battery/ accumulator voltage display is below 3V for batteries or 3.5 V for rechargeable batteries, the running time left amounts to a maximum of 2-4 hours!
  In this case, replace the battery before starting the measurement!

- ❑ Slide the plate with the test source on the detector and read the measured value after approx. ten seconds. After this interval, a sufficient measuring accuracy is given.
- ❑ Compare the measured value to the nominal value indicated on the test source for the respective detector type and for the selected source type. Your device only works properly, if your measured value lies within the indicated permissible variation range.

Please note: Regular functional checks are prescribed in § 67 of the German Radiation Protection Act. You should therefore perform them at least weekly and, of course, immediately in case you suspect that there is a device error.

5.1.2 Measuring and Storing the Background

The background, i.e. the ambient radiation, is measured in CPS. It is automatically subtracted in the course of the sample measurements. The gross and raw data values can be displayed simultaneously.

Procedure

- ❑ On the **System Menu**, choose the option **Background**. The background parameters and the start option are displayed.

Figure 11: ***Background*** *menu*

- ❑ Set the desired parameters for the background measurement.

α-background Shows the currently stored α-background value. It can be the result of a background measurement or can be entered manually. It can be the result of a background measurement or can be entered manually. The stored background is subtracted during each measurement.

βγ-background: Shows the currently stored background. It can be the result of a background measurement or can be entered manually. The stored background is subtracted during each measurement.

Preset Time: Enter the desired measurement time. To receive accurate results, you should enter an interval of at least 60 seconds

Precision: Enter the desired precision for the α and the βγ measurement channel.

Threshold: Enter the desired threshold which, when exceeded, triggers an alarm (applies to both measurement channels).

Autostart: When **ON** is set, with every start-up of the device, first of all a background measurement will be executed automatically.

- Start the background measurement by moving the cursor (→) to **Start** and pressing the ENTER key. Then the background measurement starts.

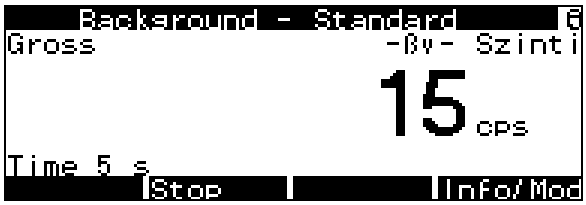


Figure 12: Background measurement

- On the display, the measured values and the passed measuring time are permanently indicated. At the end of the measuring period, the determined background value is displayed for both measurement channels.
- End of the background measurement: When the preset measuring time has passed or by pressing the **Stop** key. Now the following softkeys are activated: **Store** the background, **Start** a new background measurement, back to the **System Menu** and **Info**.

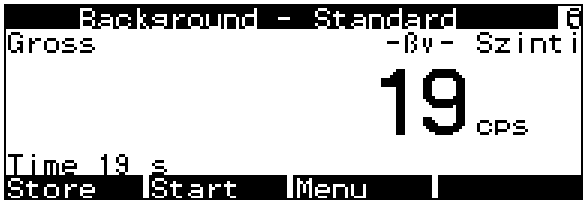


Figure 13: Display at the end of a background measurement

- Choose the option **Store** by pressing . The stored background value is displayed in the **Background** menu next to **α-background** and **βγ- background** (see Figure 11).

The background value should be measured and stored daily and whenever the device is used in a different environment; otherwise you will get false results!

Automatic Background Measurement

When the autostart function is activated, every time the device is switched on, a background measurement with the preset parameters is executed.

After the end of the background measurement (measuring time over or stop) the determined value can be stored with the **Store** key , or a new background measurement can be started with **Start** (ENTER).
The softkey of the key will only change from **Store** to **Continue** when the determined background value has been stored. By pressing **Continue** the contamination measurement can be started.

Please note: In this case the softkey **Start** refers to the starting of the background measurement. **Continue** starts the contamination measurement.

Procedure

Automatic background measurement after power on of the device.

Background measurement finished (at the end of a measurement or by pushing **Stop**)

Store the background values

Start the measurement

5.1.3 Creating the Small Nuclide Table

To be able to select particular nuclides for a sample measurement, you first have to select the nuclides from the existing nuclide table that you use most frequently and that you wish to fetch directly during measurements. These nuclides are then stored in a small nuclide table that you can access directly via the softkey **Nuclide** during measurements. The scope of the small nuclide table is adjustable (minimum: net; maximum: all nuclides).This allows you to switch to another nuclide at any time. According to the profile the small nuclide table already contains some of the most common nuclides when the device is delivered (see chapter 6.6).
At the same time, you can enter **Alarm thresholds** for these nuclides; when they are exceeded, an alert signal sounds.
If the nuclide or nuclide compound you wish to measure is not yet contained in the small nuclide table, proceed as follows:

- ❑ Select the option **Nuclides** on the **System Menu**.

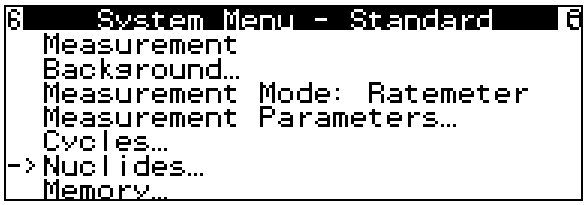


Figure 14: System menu

- ❑ Press the ENTER key. The nuclide table is displayed. The nuclides contained in the small nuclide table, are marked with a tick.

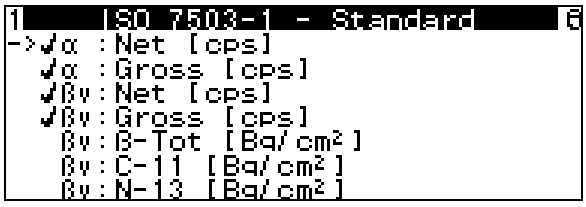


Figure 15: Nuclide table. The pre-selected nuclides are marked by a checkmark.

- ❑ Move the cursor to the nuclide you wish to include in the small nuclide table using the ▲▼ key, and then press the ENTER key. The selected nuclide is now marked with a tick
- ❑ Quit the nuclide table with ESC. You will get back to the **System Menu**.

Entering alarm thresholds

Be cautious if you modify the nuclide parameters!

Procedure

- ❑ Move the cursor (->) to the desired nuclide.
- ❑ Press the ENTER key for approximately one second.
- ❑ This brings you to the page where you can edit the parameters for the respective nuclide (see 4.4.2 and 6.6).
- ❑ Enter the desired threshold value.
- ❑ Confirm the entry by briefly pressing the ENTER key.

Measuring contaminations

There are two measurement modes for surface contaminations:
1. Measurement of the net count rate in CPS (counts per second).
2. Measurement of the net area activity with the unit Bq/cm², where you have to select the nuclide or nuclide compound to be measured.

Both measurement modes can be performed either in the ratemeter, survey or scaler-timer measurement mode.

The measuring channel (α, $\beta\gamma$ or α and $\beta\gamma$) is selected by pushing the **Info/Mod** key for a longer period of time. The measurement mode and the nuclides are selected on the Measurement menu by repeatedly pressing the **Nuclide** key. For this purpose, you pass through the nuclide table of preselected nuclides (small nuclide table) cyclically and the measurement mode **Net [cps]**. The selected nuclide is displayed on top of the display, on the left side. When scrolling through the small nuclide table, only the nuclides of the selected measuring channel (radiation type) will be displayed: If only the $\beta\gamma$-channel is set on the Measurement menu, only the $\beta\gamma$-nuclides will be displayed when you scroll through the small nuclide table. For simultaneous α-/$\beta\gamma$-measurement, the nuclides will be displayed and selected separately for each type of radiation.
The user chooses the most frequently used nuclides and measurement modes from the nuclide table (e.g. **Net [cps]**, **B-1**, **B-2**, **β-Tot**, **C-14 -** see chapter 6.6).
You can switch between the pre-selected items of this table during the measurement by pressing ENTER.

Each display contains the current measured value, the unit of measurement and, on the left, the selected nuclide or the **Net [cps]** measurement mode. With each change of the display, the measured value for the new position is displayed practically without time delay.

The detector has to be held as closely as possible to the surface to be measured (be cautious not to damage the foil!). Depending on the count rate level, different measuring intervals are recommended to obtain as low a statistical fluctuation as possible. When the statistical fluctuations decrease, this is apparent from the fact that the indicated measured values show less and less deviations. The stored background value is automatically subtracted.

CPS measurement

Start the measurement by selecting the desired measurement mode (**Ratemeter**, **Scaler/Timer** ...) on the **System Menu**, and then select the item **Measurement** or push the ESC button.
If the **Net [cps]** mode is not yet selected, choose this setting from the small nuclide table. Press the **Nuclide** key until **Net** appears in the second line of the display (see Figure 16:).

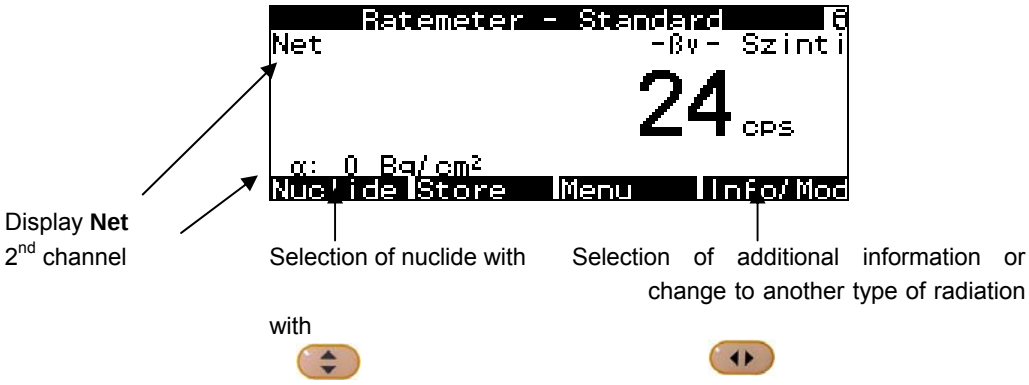


Figure 16: CPS measurement

Press the **Info** softkey to view further information on the current measurement on the display (see chapter 4.2).

Measuring the Area Activity

Start the measurement by selecting the desired measurement mode (**Ratemeter**, **Scaler-Timer** ...) on the **System Menu**, and then **Start**.

- First, set the desired measurement channel (type of radiation) by pushing the **Info/Mod** key (long): Display of the α-, the βγ- or both measurement channels at the same time.
- Then select the nuclide to be measured:
  - If only one measurement channel is displayed, push the **Nuclide** key repeatedly until the desired nuclide appears in the second line of the display.
  - If both measurement channels are displayed, push the **Nuclides** key first. Then the function of the softkeys changes. Now you can set the α- and the βγ-nuclides separately by pushing the α ENTER or βγ ESC key.

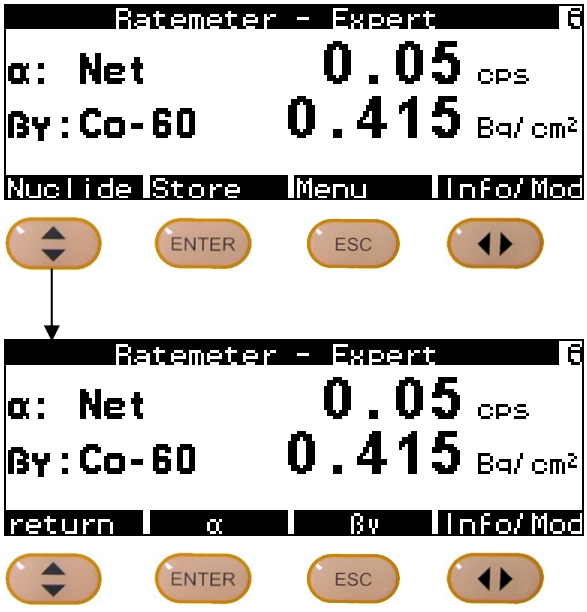


Figure 17: Nuclide selection for simultaneous α-/βγ-measurement

In the selected measurement mode (Bq/cm²), the count rates detected (cps) are converted into area activities with the help of a calibration factor stored in the device (Bq/cm²). The background value that you have stored will automatically be subtracted, so that the indicated results are always net area activities.
Press the **Info** softkey to view further information on the current measurement on the display (see chapter 4.2).

5.2 Explanations of the Different Measurement Modes

In the following paragraphs, you will learn to choose the correct measurement mode for each situation, and what differences there are between the individual modes:

Net [cps]

Counts per second
In this measurement mode, the net count rate determined by the detector is displayed, on the condition that a background value is stored. The gross count rate can additionally be displayed.

This measurement mode is used to determine a general change in the degree of contamination or the radiation level.

Bq/cm² β-Tot

Area activities - beta-radiation (total)
In this and the following measurement mode, the detector count rates (cps) are converted into area activities (Bq/cm²) using a calibration factor stored in the device. The stored background value is automatically subtracted.
β-Tot means "beta total". In this case, the conversion factor is not related to a specific radio nuclide, e.g. iodine-131, but is based upon the mean factor of a nuclide compound that is typically to be expected after a reactor accident.

This measurement mode is used when
a) you wish to check whether the limit value for surface contamination according to prescriptions or regulations has been exceeded
b) the contamination has been caused by a recent power station accident and its composition is not known.

Bq/cm² 137 Cs (or other nuclide)

In this measurement mode, the conversion factor is related to the area activity of one specific nuclide. The nuclide can be fetched from the preinstalled nuclide library.

This measurement mode is used when
a) you wish to check whether the limit value for surface contamination according to prescriptions or regulations has been exceeded and
b) you know the radio nuclide causing the contamination.

If you are dealing with a compound of radio nuclides and you know the individual nuclides, you make use of a so-called tracer; this will either be the nuclide that is the major constituent of the compound, or the most dangerous one (with fresh fission products, this will almost always be iodine-131).

Attention! *This does not mean that in this measurement mode, the monitor is able to measure purposefully and selectively the contamination caused by a specific radio nuclide within a compound. It just values the contamination as if it was caused by the respective radio nuclide.*

B-1 or B-2

In this measurement mode, a conversion factor is used that the user has entered and that refers to a singular nuclide or nuclide compound that is not part of the nuclide library of the LB 124 Scint.

This measurement mode is used when

a) you wish to measure a nuclide that is not part of the nuclide library. For this purpose, the device has to be calibrated with the help of a respective test source
b) you wish to measure a specific nuclide compound consisting of some of the nuclides from the nuclide library.

5.3 Accuracy of the Display in Bq/cm²

The calibration factors determined by the manufacturer and stored in the LB 124 Scint in the setting A-100 (see chapter 6.8.3) for the indication in Bq/cm² refer to calibration sources of 10 cm x 10 cm and to a surface emission rate certified by the German Calibration Service DKD.
Comparative measurements with other devices also indicating their results in Bq/cm² will therefore only produce corresponding results, if these devices have also been calibrated with sources of the same kind. If, in your comparative measurements, you get results differing from the ones that the LB 124 Scint displays, please check whether
a) the same radio nuclide has been selected and
b) the source used for the calibration meets the requirements mentioned above.

For surface contamination measurements, the extent of the contamination in relation to the standardized area of 100 cm² of the calibration source has to be taken into account as well.

For measurements according to § 44 of the German Radiation Protection Ordinance the averaging area may be up to 300 cm². The measurement area of the LB124 Scint is 118 mm x 145 mm (171 cm²) at a transmission of 80 %.

For contaminations with an extent of less than 100 cm², the averaging takes place automatically according to the above-mentioned calibration conditions. A contamination of, for example, 10 Bq/cm² with an extent of only 50 cm² will accordingly be displayed as 5 Bq/cm² (referred to 100 cm²).

If, however, the extent of the contamination is larger than 100 cm², the monitor will overvalue it: It will indicate 10 Bq/cm², distributed over 150 cm², as 15 Bq/cm².

5.4 Exceeding of Threshold Values

Any exceeding of user-defined threshold values is indicated on the display next to the measured value by the message “Alarm” and the type of radiation (α or $\beta\gamma$). In addition, an alarm signal is actuated (visually as a flashing LED, acoustically as a brief alarm sound or as vibration), if preset (see System Menu: Parameter->Alarm, chapter 6.8.6). Alarm will be indicated in any case, regardless of the measurement mode you are in.

Figure 18: Exceeding of threshold values

The display shown below appears if the entrance window is damaged (light gets inside the counting chamber) or if the count rate range is exceeded. In this case, turn the device off, check for possible contamination and the entrance window for leaks. If necessary, replace the window foil (see chapter 7.2).

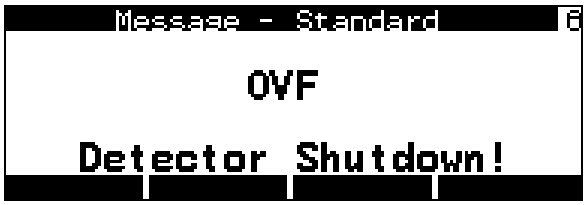


Figure 19: Error message if range is exceeded

6. Software Functions

You will find a detailed description of the software operation in chapter 4 (how to select the **System Menu**, how to select menu items, how to edit things etc.).
All menu items can be selected from the **System Menu**.

Only those menu items are displayed for which the user has a respective reading or editing authorization. The user rights are defined and stored in user-specific profiles. In the top line of the display, the current profile is indicated. Only the owner of the PIN number has the right to define and modify a profile (see chapter 6.9). When you turn on the device, the profile is loaded which had been active when the device was switched off. To change profiles, select the **Profile** menu.

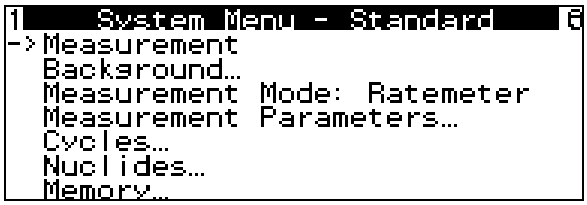


Figure 20: System menu

The individual menus and options are explained on the following pages.

Chpt.	System menu	Options		
6.1	Measurement			
6.2	**Background**	Start		
		α-background/ βγ-background		
		Preset Time		
		α-Precision		
		βγ -Precision		
6.3		Threshold		
		Autostart	OFF, ON	
6.4	**Measurement Mode**	Ratemeter, Scaler-Timer, Survey, Clearance, Half-life Value		
	Measurement Parameters	Preset Condition	Measuring Time, Counts, Precision	
		Time Constant		
		σ-Factor		
		α-Nuclide		
		α-Threshold		
		βγ-Nuclide		
6.5		βγ-Threshold		
	Cycles	Mode	Single, Increment, Forever	
		Cycle time		
		Number Cycles		
		Autostore	OFF, ON	
6.6		Autoprint	OFF, ON	
6.7	**Nuclides**	Nuclide List		
	Memory	Store Current Value		
		Show Memory		
		Print Memory		
6.8		Erase Memory		
	Parameters	Language	German English	
		Date/Time	Year	
			Month	
			Day	
			Hour	
			Minute	
			Second	
			Weekday	
		Calibration	ISO 7503-1, A-100	
		Grid Transmission	α-/βγ-Grid transmission	
		Alarm	Optical	OFF, ON
			Acoustic	OFF, ON
			Vibration	OFF, ON
		Ticks	αTicks	OFF, ON
			βγTicks	OFF, ON
		Light	Light, middle, dark	
		RS 232	Remote access	
			Device address	
			Baudrate	
			Parity	
			Data bits	
			Stop bits	
		Power Supply	Battery Type	Accu, Battery
			Charge Mode	OFF, ON
			Charge Time	
			System Timeout	
			Line Voltage	
6.9			Voltage battery	
		Hardware	Detector Type	
			S/N Detector	
			S/N Instrument	
			Control voltage HV	
			Display	
	Profile	Select Profile	Standard, EASY, EXPERT	
		Edit Profile (PIN)	New Profile	
			Delete Profile	
			Edit Profile	
			Quit Editing Profile	
			Change PIN	
			Factory Setting Profile	

6.1 Measurement

Choose this menu item (or press the ESC key on the **System Menu**) to go to the **Measurement Menu**. The measurement will be started automatically in the selected measurement mode with the appropriate parameters set.
The active measurement mode is shown in the first row of the display.

Figure 21: Measurement Menu ratemeter mode

The following table shows the 5 possible measurement modes and the associated selection options via the softkeys. Depending on the device status, different functions can be selected:

Measurement Mode	***Status***	↕	ENTER	ESC	◀▶
Ratemeter	Measurement	**Nuclide**	**Store**	**Menu**	**Info/Mod**
Scaler-Timer	Stop/ Run	**Store / Nuclide**	**Start/ Stop**	**Menu**	**Info/Mod**
Survey	Measurement	**Nuclide**	**Store**	**Menu**	**Info/Mod**
Survey	Stop/ Run	**Store / Nuclide**	**Start/ Stop**	**Menu**	**Info/Mod**
Half-life	Stop/ Run	**Store**	**Start/ Stop**	**Menu**	**Info/Mod**

↕ **Nuclide** — Selection of the desired nuclide from the small nuclide table, depending on the set measurement channel. (The content for the small nuclide table is selected on the **Nuclide** menu). You can select the nuclides during the measurement or on the **Measurement Parameters** menu. You can store the measuring result with this key, when the measurement has been stopped.

↕ **Store** — Storing the measuring results of the stopped or finished measurement in the **Scaler-Timer** mode.

ENTER **Store** — Storing the measuring results in the Ratemeter mode.

ENTER **Start/Stop** — Start or Stop a measurement in the **Scaler-Timer** mode.

ESC **Menu** — Back to the **System Menu**.

Info/Mod

A long push (until the clock symbol appears in the top left corner) changes the measurement channel which appears as main display: βγ-measurement channel → both measurement channels → α-measurement channel (see chapter 4.2) **Repeatedly pushing this button** for a short time shows the information shows the information of the on-going measurement. Depending on the measurement mode, the following additional information is displayed:

Additional display of **measured value of the 2nd channel** (here alpha channel)

%-scale. This bar chart shows the ratio between the respective measured values and a set threshold value. Indication in percent of the threshold value. If the threshold is exceeded, the left LED is flashing and an acoustic alarm is triggered – if preset. Next to the graph, the respective multiplication factor is indicated: x10; x100; x10x100.

Accuracy of 1st measurement channel

Threshold value and calibration factor of the 1st measurement channel

Date and time

Background which is subtracted, and the **measurement time** used for measuring the background.

Minimum and maximum value of the current measurement in the 1st measurement channel.

Raw data value in the 1st measurement channel in cps.

Gross measured value

In case of simultaneous α-/$\beta\gamma$-measurement, only the current accuracy for both channels and the date/time are displayed.

6.2 Background

Upon selection of this menu, the following options are displayed:

Figure 22: Background menu with options

The currently stored background is subtracted in every measurement (in every measurement mode).

→Start

Starts the background measurement in both measurement channels at the same time using the parameters defined on this page.
In the line **Current Value:** the background value can also be entered manually if the respective rights have been allocated.

Background Measurement

a) Running measurement (after 14 seconds)

b) Measurement stopped after 85 s

Figure 23: Background measurement

a) While a measurement is running, you can change the display of the measurement channels and the info line.
b) At the end of the measurement, the background values (α and βγ) can be saved (**Store** key) and information on the measurement can be viewed (**Info** key).

*In the background measurement mode, there is no alert threshold; the bar graph, however, indicates a relation to the alert threshold defined in the nuclide table for [**Net cps**].*

In the background measurement the softkeys have the following functions:

Measurement Mode	*Status*				
Background	Stop/ Run	**Store**	**Start/ Stop**	**Menu**	**Info/Mod**

 **Store**

This softkey is only displayed when the measurement has finished. By pressing this key you can store the measured background in the **Background** menu in the line **Current Value**.

 **Start/Stop**

Stop is displayed during running measurement, **Start** when measurement has been stopped or finished.

 **Menu**

Back to the **Background** menu.

 **Info/Mod**

Push this key repeatedly for a <u>short time</u> to view the following additional information:
2nd measurement channel
%-Scale. This bar chart shows the ratio between the respective measured values and a set threshold value. Indication in percent of the threshold value. When the threshold is exceeded, the left LED flashes and – if preset – an acoustic signal is actuated. Next to the graph, the respective multiplication factor is indicated: x10; x100; x10x100.
Precision
Threshold value and calibration factor
Date and time
Minimum and maximum value

<u>Push this key for a longer time</u> to change the measurement channel:
α-measurement channel → $\beta\gamma$-measurement channel → α–+ $\beta\gamma$-measurement channel.

Negative values

For statistical reasons, the stored and subtracted background value may be higher than the current count rate. This is indicated by a minus sign in front of the numerical value 0.0 on the display in the ”Bq/cm²” measurement mode. Negative values are suppressed in order to avoid a confusion of the user.
If the negative values are indeed only a result of the statistical fluctuations, the minus sign will appear and disappear at irregular intervals. This indicates that the stored and the currently measured background values agree in the mean value.
If, however, the minus sign is permanently present, this indicates that the stored background value is too high. In this case: check the background value and measure it again, if required; then store the new value!

Measuring period

To obtain accurate results, the background measurement should take at least 60 seconds!

The background value should be measured and stored daily and with each change of the ambience, because otherwise you will get false results in the Bq-measurement mode!

The stored background value is displayed in the background menu in the line current background value. This value is subtracted from every Bq measurement.

→ α or βγ Background

Here the currently stored background value is indicated. It can result from a background measurement (see above) or it can be entered manually.

Manual modification:

- ❑ After choosing this option, press the ENTER key.
- ❑ Move the cursor with the ◄► key to the desired position, and set the desired number by repeatedly pressing the ▲▼ key.
- ❑ In case it is a multi-digit number, use the ◄► key to change to the next place and enter this number in the way described above.
- ❑ When the desired number has been entered, press the ENTER key. Thus the entered number is stored as the new background value.

Figure 24: Background measurement parameters

→ Preset time

Here you enter the measurement time in seconds. To obtain accurate measuring results, the measurement time should be at least 60 seconds. Please keep in mind that the preset measurement time limits the background measurement, regardless of the accuracy that has been reached! If the preset accuracy is reached earlier, the background measurement will be stopped.
The actual measurement time can be viewed by pushing the **Info/Mod** key. It is stored internally and is taken into account for further calculations.

→ Precision

Enter the desired precision for the α and the $\beta\gamma$ measurement channel. As soon as the preset accuracy for both channels has been reached, the background measurement will be stopped (even if the preset measurement time has not yet been reached).

→ Threshold

Enter the desired threshold which, when exceeded, triggers an alarm (applies to both measurement channels).

→ Autostart

Here you can switch on (**ON**) or off (**OFF**) the function autostart. With autostart on, every time the device is started, a background measurement with the preset parameters automatically will take place. After finishing the background measurement (by manual stop or after expired measuring time) the determined background value has to be stored by pressing the softkey **Store**. Only then you can start the Bq measurement by pressing the **Continue** key.

Please note: With the autostart function enabled, you can start a measurement only when the result of the current background measurement has been stored.

6.3 Measurement Mode

The measurement mode is selected on this menu. This setting refers to the two menus **Measurement** and **Measurement Parameters**.
***The Parameters displayed on the menu Measurement* Parameters are valid only for the preset measurement mode.**
Modifications are also stored depending on the measurement mode. The measurement mode started on the **Measurement** menu is also determined on the **Measurement Mode** menu.

Example: Scaler-Timer is set.
If **Measurement** is selected, a scaler-timer measurement is carried out using the parameters which have been preselected on the **Measurement Parameters** menu. Furthermore, all general parameters are activated, for example: background value (or autostart); nuclides and nuclide parameters. If the measurement parameters are modified and stored on the **Measurement Parameters** menu, they are only allocated to the scaler-timer mode.

Procedure

On the **System Menu**, the currently set measurement mode is displayed next to the option **Measurement Mode**.

- ❑ In order to modify the setting, select the option **Measurement Mode** (→) and push the ENTER button. After that the current setting is marked by a bar.
- ❑ Press the key repeatedly to scroll through the selectable measurement modes in a cyclical order.
- ❑ If the desired measurement mode is displayed, press the ENTER key to confirm the selected setting.

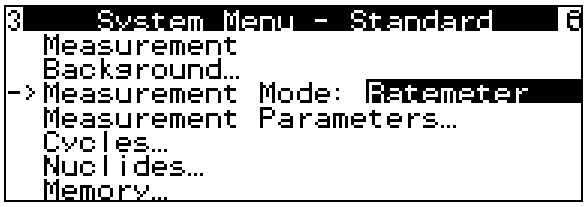


Figure 25: Measurement mode selection

6.4 Measurement Parameters

6.4.1 Ratemeter

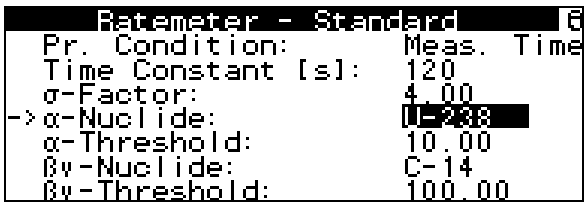


Figure 26: Parameters for ratemeter measurements

→ Preset Condition Here the type of averaging is defined. The alternatives are **Meas. Time** / **Precision**.

→ Time Constant Here you enter the desired time constant, i.e. the time in which the averaging algorithm works. With short measuring intervals, the measurement is more sensitive (see chapter 8.2).

→ Precision ε [%] The time constant corresponds to the period of time required to reach the preset accuracy with the current count rate.

→Sigma factor σ Preselection of the number of standard deviations that defines the deviation of the current measured value from the mean value that has to occur before the time constant is reset to 1 (reject criterion, see chapter 8.1)

→ α-nuclide Select the α-**nuclide** or **Net** or **Gross** from the small nuclide table to enter a threshold value or to display a possibly existing threshold value.

→ α-threshold Enter the desired α-threshold value for the nuclide pre-selected under **α-nuclide**. If this value is exceeded, the LED is flashing and an alarm signal – if preset – is triggered.

→ βγ-nuclide Select the β-**nuclide** or **Net** or **Gross** from the small nuclide table to enter a threshold value or to display a possibly existing threshold value.

→ βγ-threshold Enter the desired βγ-threshold value for the nuclide pre-selected under **βγ-nuclide**. If this value is exceeded, the LED is flashing and an alarm signal – if preset – is triggered.

6.4.2 Scaler-Timer

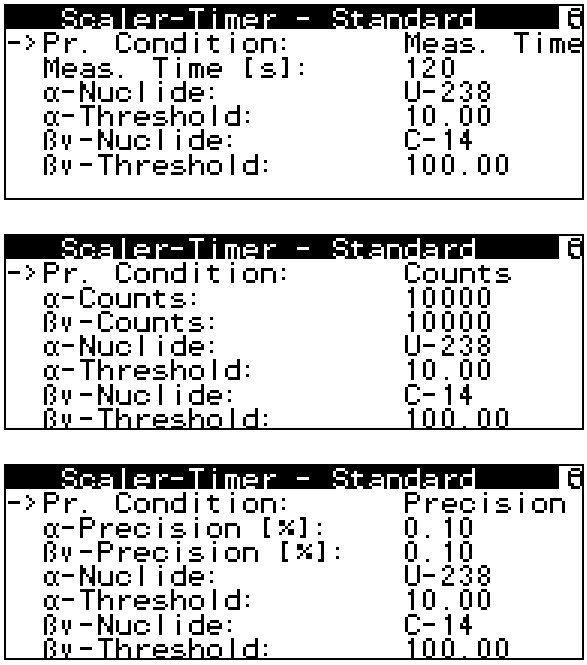


Figure 27: Parameters for a Scaler-Timer measurement, depending on the selected preset condition

→ Preset Condition

Here you can define the parameter that determines the end of the measuring process: The predefined **Measuring Time**, the number of **Counts** or the **Precision**. Depending on this selection, either the desired measurement time, the number of counts or the accuracy are displayed in the following line.

→ Meas. Time

Define the measurement time, if measurement time has been selected as preset condition.

→ α-Nuclide
βγ-Nuclide

Shows the integrated α- and βγ-counts as a measure of the statistical accuracy (if counts have been selected as preset condition). When the defined value is reached, the measurement is terminated. The statistical error (1-σ-error) is calculated as follows:

$$\text{Statistical error} = \frac{1}{\sqrt{\text{counts}}}$$

Example:

$$10{,}000 \text{ counts} = \frac{1}{\sqrt{10{,}000}} = \frac{1}{100} = 1\%$$

For a measuring accuracy with a statistical error of 1%, 10,000 counts have to be entered or, to put it differently, only after 10,000 counts the desired measuring accuracy will be reached. It is apparent from this that low activities will result in long measuring periods.

Please keep in mind that the pre-selected preset condition is valid for both measuring channels and a *simultaneous* α-/βγ-measurement always takes place. Therefore, a measurement will be terminated only when the preset counts for both measuring channels have been reached.
For example: If you just want to measure the βγ-activity and the α-radiation is negligible, then you should set the α-counts correspondingly low or to zero.

→ **α-Precision**

βγ- Precision Define the accuracy for the α and the β measurement channel in % which is to be used for measurement. This parameter is displayed when the accuracy has been selected as preset condition. Please note that the measurement will be terminated only when the accuracy for both measuring channels has been reached. If you only wish to measure the βγ-activity (at an expected low α-activity), you should set the accuracy of the α-channel to 100% to make sure the measurement time will not be extended unduly.

→ **α-Nuclide** Select the **α-nuclide** or **Net** or **Gross** from the small nuclide table.

→ **α-Threshold** Enter the desired α-threshold. When it is exceeded, the LED is flashing and – if set – an alarm signal is triggered.

→ **βγ-Nuclide** Select the **βγ-nuclide** or **Net** or **Gross** from the small nuclide table.

→ **βγ-Threshold** Enter the desired βγ threshold. When it is exceeded, the LED is flashing and – if set – an alarm signal is triggered.

6.4.3 Survey

Figure 28: Parameters for survey mode

→ Time constant Enter the desired time constant.

→ α-Precision
βγ- Precision Define the accuracy for the α and the β measurement channel in % which is to be used for measurement.

→ α-nuclide Select the **α-nuclide** or **Net** or **Gross** from the small nuclide table to enter/show the respective threshold.

→ α-threshold Enter/Show the desired threshold value of the preset α-nuclide. An alarm signal will be triggered when this value– if set – is exceeded.

→ βγ-nuclide Select the **βγ-nuclide** or **Net** or **Gross** from the small nuclide table to enter/show the respective threshold.

→ βγ-threshold Enter/Show the desired threshold value of the preset βγ-nuclide. An alarm signal will be triggered when this value– if set – is exceeded.

6.4.4 Clearance

For **clearance measurement**, a limit value is defined and an alarm signal will be triggered if this value is exceeded. The display shows: **CONTAMINATED** (otherwise **NOT CONTAMINATED**). Push the **Info** softkey to view the channel that is contaminated.

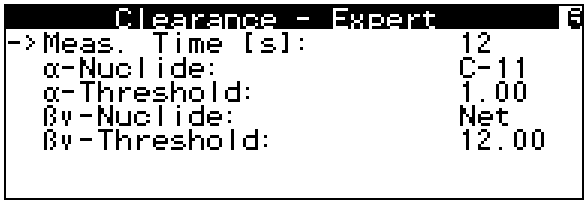


Figure 29: Parameters for clearance measurement

→ Measurement time Enter the desired measurement time (time constant).

→ α-Nuclide Select the **α-nuclide** or **Net** or **Gross** from the small nuclide table to enter/show the clearance limit of this nuclide.

→ α-Threshold Enter the desired clearance limit of the preset α-nuclide. When this value is exceeded – if set – an alarm signal will be triggered and at the end of the measurement **CONTAMINATED** appears on the display.

→ βγ-Nuclide Select the **βγ-nuclide** or **Net** or **Gross** from the small nuclide table to enter/show the clearance limit of this nuclide.

→ βγ-Threshold Enter the desired clearance limit of the preset βγ-nuclide. When this value is exceeded – if set – an alarm signal will be triggered and at the end of the measurement **CONTAMINATED** appears on the display.

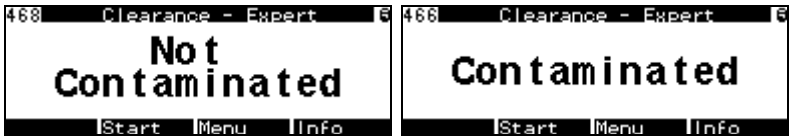


Figure 30: Display upon completion of a clearance measurement

6.4.5 Half-life

This type of measurement is selected to determine nuclides in unknown radiation substances.
Several measurements will be carried out (the number of measurements has to be set on the **Cycles** menu) and these measurements are used by the program to calculate the half-life period.

Figure 31: Parameters for half-life measurement

→ Meas. Time

Duration of single measurements in seconds. How many measurements are carried out in succession is defined on the **Cycles** menu. The longer the measuring time and the higher the number of cycles, the more accurate will be the result of the measurement.

→ σ-Factor

Enter the Sigma factor. Enter the number of standard deviations that defines how much the currently measured value may deviate from the mean value before the time constant is reset to 1 (reject criterion, see chapter 8.1).

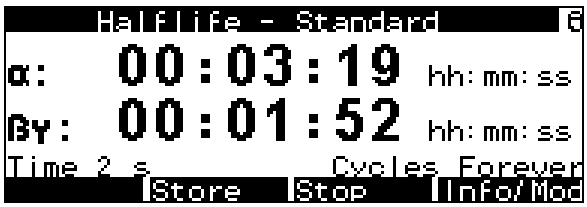
→ α-Precision
βγ-Precision

Enter the relative precision for the α- and the βγ-measurement channel that is to be reached before the start value will be taken.
Please note that the measurements will start only when the set accuracy has been reached! Therefore, enter the desired accuracy for the expected radiation type, for the other radiation type e.g. 100%.

Half-life measurement procedure

- A net measurement is started when you go to the measurement menu with the measurement mode "**Half-life period**" preset.
- As soon as the preset accuracy for both measuring channels is reached, the half-life measurement starts and the counts per second are displayed. The accuracy or the preset number of measurement cycles including the number of the current measurement cycle (or Forever) can be displayed for your information at the bottom of the display (see Figure 32:a).
- Once the preset measuring time of the first measurement cycle is over, the half-life period determined so far is displayed.
- Then the next measurement cycles are run and the determined half-life period is refreshed on the display after each measurement cycle.
- Upon completion of all measurement cycles, the final result appears, which can be stored (see Figure 32:b). The row number is displayed in the top left corner of the display, which has the result of the half-life measurement in the memory.
- If no statistically significant drop was detected, this will also be indicated.

a) Running half-life measurement



b) Result of a half-life measurement

Figure 32: Half-life measurement

6.5 Cycles

The cycle parameters for all measurement modes are defined on this menu:

Here you define whether

- ❑ the measurement is to take place only once ("**Single**")
- ❑ the measurement is to be carried out repeatedly ("**Forever**")
- ❑ a predefined number of measuring cycles is to be executed ("**Increment**"). In this case, you will be prompted to enter the number of cycles.

→ Mode

Here you can choose between **Single** (single measurement), **Increment** (predefined number) and **Forever**. Depending on the selected mode and the preset measurement mode, the individual parameters and their meaning may differ:

a) Single

the measurement is carried out only once.

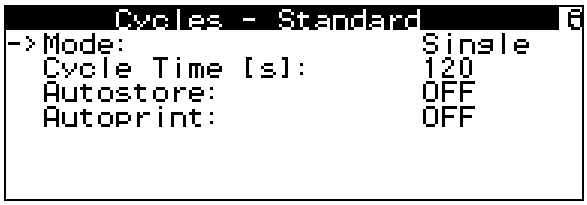


*Figure 33: **Cycles** menu - **Single** setting*

→ Autostore

Here you can enable (**ON**) or disable (**OFF**) the automatic storing function. Stored data can be printed on the **Store/Print Memory** menu or viewed on the display on the **Store/Show Memory** menu (see chapter 6.7). During the storage process, the current storage is displayed in the top left corner of the display.

→ Autoprint

Here you can enable (**ON**) or disable (**OFF**) the automatic printing function. If this function is active, the measured results are printed automatically.

b) Increment Enter the desired number of cycles.

*Figure 34: **Cycles** menu - **Increment** setting*

→ Cycle time Cycle time, depending on the measurement mode:
In case of scaler-timer, clearance and half-life measurements the cycle time corresponds to the measurement time. It is taken from the measurement settings of the respective measurement mode. In the ratemeter mode (= the measuring time is not limited), the measuring results are stored and printed according to the interval defined here.

→ Number of cycles Enter the number of measurement cycles.

→ Autostore and Autoprint Same as **Single** mode. The results will be stored and printed following every cycle.

c) Forever Continuous measurement mode.

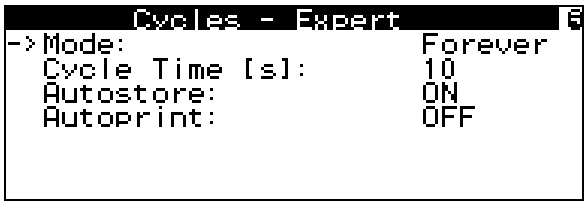


*Figure 35: **Cycles** menu - **Forever** setting*

→ Cycle time Cycle time, depending on the measurement mode:
In case of scaler-timer, clearance and half-life measurements the cycle time corresponds to the measurement time. It is taken from the measurement settings of the respective measurement mode. In the ratemeter mode (=the measuring time is not limited) the measuring results are stored and printed according to the interval defined here.

→ Autostore and Autoprint Same as **Single** mode. The results will be stored and printed following every cycle.

6.6 Nuclides

Display of the nuclide table with edit function.

When you select this menu option, the first 7 nuclides of the nuclide table are displayed. The cursor is located at the top position of the table. By briefly pressing the key, you can move the cursor to the bottom; by pressing longer, you move to the top.

By briefly pressing the key, you can scroll forward within the table; by pressing longer, you can scroll backward. This way you can scroll the whole nuclide table.

Pushing the ENTER button for a longer time takes you to the parameters of the selected nuclide.

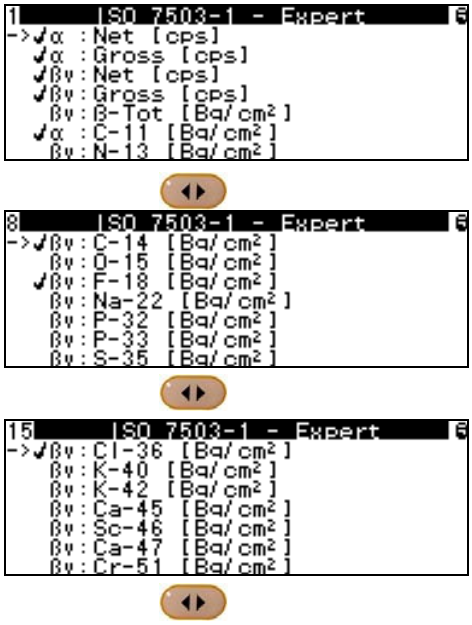
Contents of the nuclide table

The nuclide table contains at present 56 nuclides with their calibration factors, a nuclide compound for beta-radiation sources "**β-Tot**" and two positions ("**B-1**" and "**B-2**") which the user can use for his own calibration factors. Moreover, the table contains the measurement modes **Net [cps]** and **Gross [cps]** for alpha and for beta-gamma sources.

There is a preset calibration factor, a threshold value and a measuring unit for each nuclide; all of them can be edited by the user.

Selection for small nuclide table

In the nuclide table, individual nuclides can be selected for the small nuclide table (Measurement Menu) (see 5.1.3). You choose a nuclide for this selection by moving the cursor (→) to this nuclide by repeatedly pressing the button. ENTER The selected nuclide is marked with a tick (✓) and can now be directly selected for a measurement. You can undo the selection by pressing the ENTER key again.



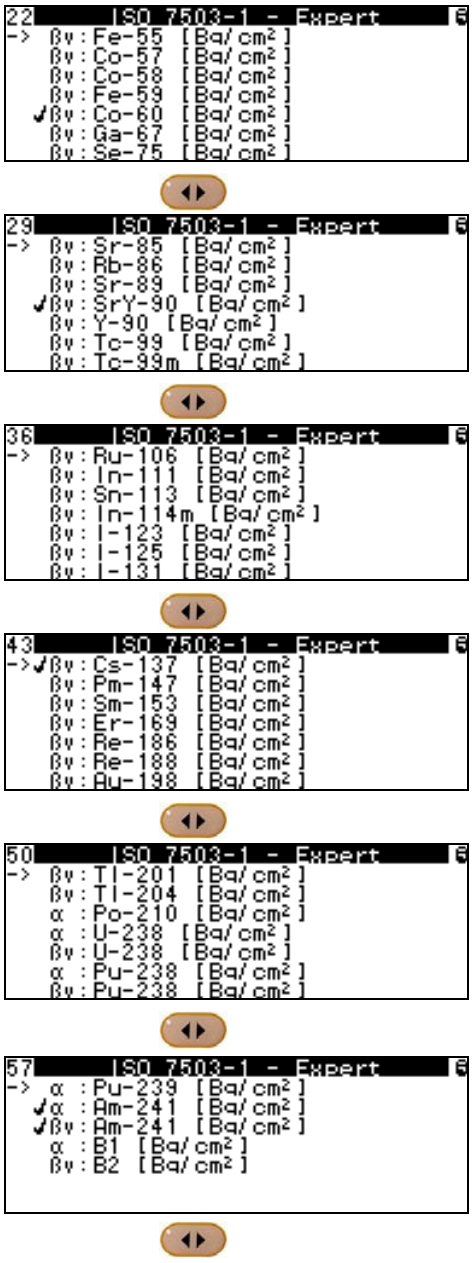


Figure 36: Nuclide table

Editing the nuclide table

Please be careful when editing the nuclide table. Only the parameters of the positions "**β-Tot**", "**B-1**", "**B-2**" and **Net [cps]** should be modified, if required. For all other nuclides, the calibration factors have already been correctly determined and set by the manufacturer. A modification of these parameters only makes sense if slight deviations are noticed in the course of time, and a new determination of the calibration factors has been performed.
The setting of the nuclide-specific threshold values, however, is relevant to the user; when these values are exceeded, there are acoustic and optical alert signals.

Procedure

- ❑ Move the cursor (->) to the desired nuclide.
- ❑ Press the ENTER key for approximately one second.
- ❑ This brings you to the page where you can edit the parameters for the respective nuclide (see Figure 37)
- ❑ Enter the desired values.
- ❑ Confirm the entry by briefly pressing the ENTER key.

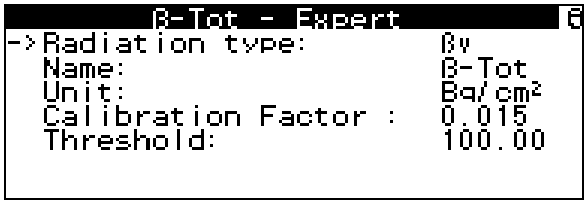


Figure 37: Editing the nuclide parameters ß-Tot)

The parameters in detail:

→ Type of radiation — Shows the type of radiation of the nuclide (α or βγ).

→ Name — Name of the nuclide.

→ Unit — Shows the unit of measurement (see below).

→ Calibration factor — In the net mode, the calibration factor is always "**1**".

→ Threshold — Alert thresholds can be defined for the individual nuclides.
If the stored alert threshold is exceeded during a measurement, the left LED will be flashing and there will be a permanent alarm tone, which will only be turned off, when you quit the measurement mode, or when the contamination sinks below the alert threshold. Moreover, the exceeding of the alert threshold can be seen in the bar graph: The percentage indication is switched with the factors 10, 100 or 1000, so that it is immediately apparent by which factor the threshold has been exceeded.

Limit values

Under the Radiation Protection Act of May 27, 1989, the following *limit values* apply to contaminations caused by beta and gamma radiation sources. The same applies to Alpha sources.

Examples four outside the monitoring area in Bq/cm²:

C	**14:**	**100**
S	**35:**	**100**
Ca	**45:**	**100**
Fe	**55:**	**100**
Ni	**63:**	**100**
Tc	**99:**	**10**
Tl	**201:**	**10**
Sr	**90:**	**1**

When the limit value is exceeded, measures have to be taken immediately to avoid the spreading of contamination. Also the measured results have to be documented in this case.

→ Unit

Select the measuring unit for the respective nuclide. You can choose from the following units:

Cps	Counts per second
Bq/cm²	Becquerel/cm² (nuclide-specific net surface active)
Bq/l	Becquerel/liter

Further units can be defined in the program.

6.7 Memory

With this menu item the memory contents can be shown on the display or output via the RS232 interface. The measured values are stored either by pushing the respective softkey or via the automatic storage function (see menu **Cycles/Autostore** in chapter 6.5)
When saving the measurement, the number under which the measured values are filed in the memory is displayed in the top left corner.
The measurements are stored in the order they have been saved in the RAM memory. The pages are numbered consecutively; one page is used for each measured value. In addition, for each measurement mode (Ratemeter, Scaler-Timer) one page is used for the header and with Scaler-Timer measurements one page for a summary. If a nuclide is changed or an alarm is triggered, this will also generate an entry.

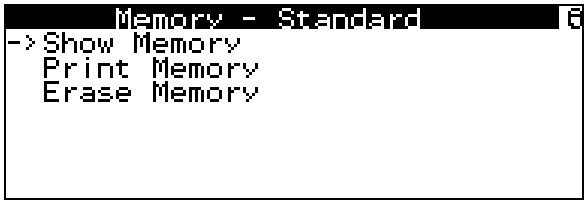


*Figure 38: **Memory** menu*

→ Show Memory

Shows the current memory contents. To get the desired results, you have the following options:

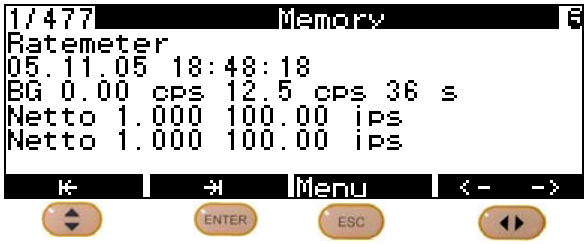


*Figure 39: **Show Memory** menu*

	short push:	Back one measurement
	long push:	Show 1st entry
ENTER	short push:	Next measurement
ENTER	long push:	Show last entry
ESC	short push:	Return to Memory menu
	short push:	Go to next page (in our example from the 1st row to the 6th row)
	long push:	Back one page.

→ Print Memory

Output of the memory contents via the RS232-interface to the printer or computer.

→ Erase Memory ***Erases the entire memory contents!***

Show memory

Example

First, you carry out a scaler-timer measurement with 3 cycles, then a ratemeter measurement, where you store 2 measurements, and then again a scaler-timer measurement with one cycle. In the memory the measured values are stored and numbered as follows:

1st page:	Header page (date, measurement mode: scaler-timer)
2nd – 4th page:	Measured values of the 3 cycles
5th page:	Summary
6th page:	Header page (date, measurement mode: ratemeter)
7th – 8th page:	Values of both measurements
9th page:	Header page (date, measurement mode: scaler-timer)
10th page:	Measured value of one cycle
11th page:	Summary

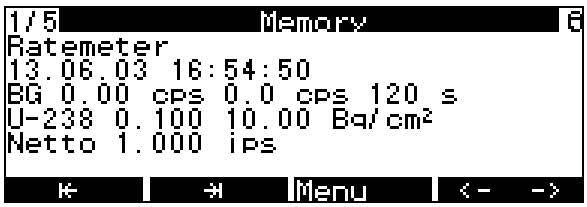


Figure 40: Show memory (1st page of 5 pages)

The above illustration shows the 1st page (of a total of 5 pages) of a ratemeter measurement. The page number is displayed in the top left corner. The first page includes the header, the following pages the measured values.
With scaler-timer measurements the last page shows a summary of the measured values from the various measurement cycles.
With a brief push on **→|** you get back to page 6, where the next measurement will start. With **->** you scroll to the next page.

1st page Header with major data of the measurement. The measurement mode is always displayed on this page. This shows that a new measurement has been started.

1st row	Measurement mode
2nd row	Date and time
3rd row	Background α (cps) and βγ (cps), measurement time of background measurement
4th row	α-nuclide, calibration factor for this nuclide, threshold value for the α-nuclide,
5th row	βγ-nuclide, calibration factor for this nuclide, threshold value for the β-nuclide (in our example Net cps has been set in this measurement channel).

2nd page

1st row empty	
2nd row	Date and time
3rd row	empty
4th row	Net result of α-nuclide, precision of measurement
5th row	Net result of β-nuclide, precision of measurement.

3rd – 5th page analog

6.8 Parameters

The following system parameters are set on the this menu:

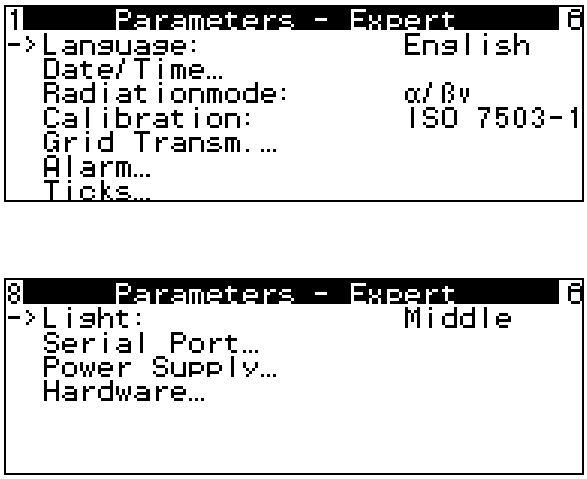


Figure 41: ***Parameters*** *menu*

6.8.1 Language

You can choose between **German** and **English** as language for the user surface.

6.8.2 Date/Time

Here the date and the time are checked and set. This information is used for the storing of measured values and for half-life value measurements.
If the memory with the time information is cleared (for example, because the LB 124 Scint has been stored without batteries), the date and the time will automatically be queried when the device is switched on. The parameters are set either by selection (month and day of the week), or numerically. The weekday is set automatically following a change; it cannot be edited.

Figure 42: Setting the date and the time

6.8.3 Radiationmode

The radiationmode can limit the display and sounding of the ticks (selection of α or βγ). If α/βγ is chosen, switching between the radiation modes α and βγ is still possible, in this case the ticks of both channels can be heared, if activated in the menu parameter Ticks.

6.8.4 Calibration

Different calibration sets can be selected in accordance with ISO 7503-1 and A-100 (calibration source with a reference area of 10cm x 10cm).

6.8.5 Grid Transmission

Display or input of a division factor, which takes into account the absorption due to the protection foil. The entry is made separately for α and $\beta\gamma$. No calculation for CPS measurements.

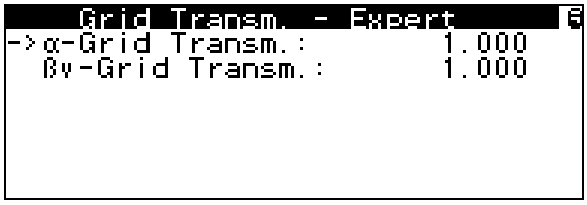


Figure 43: Enter a grid transmission factor

6.8.6 Alarm

Here you can decide whether there shall be an acoustic alarm signal when a threshold is exceeded, or an optical indication by means of the left, red LED. You can also choose both optical and acoustic signals at the same time and the volume of the acoustic signal can be regulated.

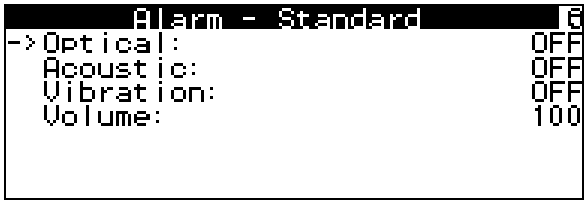


Figure 44: Alarm setting

If you choose the acoustic or optical/acoustic alert, there will be an acoustic signal in addition to the optical alarm when a threshold is exceeded. The respective thresholds are nuclide-specific and are predefined in the nuclide table where they can also be edited (see chapter 6.6). For the nuclides in the small

nuclide library, the thresholds can be edited on the **Measurement Parameters** menu (see chapter 6.4).

6.8.7 Ticks

Here you can set the measurement channel (type of radiation) in which the acoustic ticks should be audible.

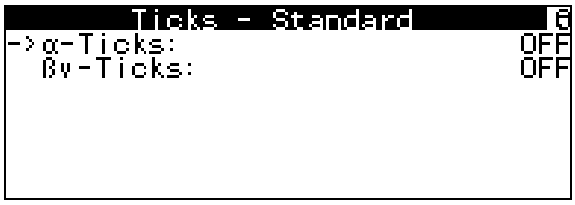


Figure 45: Selection of measurement channel for acoustic alarm

6.8.8 Light

Here you can choose the light intensity for the display: **light**, **middle** and **dark** can be selected. If no key is pushed for 60 seconds, the display illumination is turned off automatically.

Figure 46: Setting the brightness of the display

6.8.9 RS232

Data transmission via the RS232 interface is only possible, when the function **Autoprint** or **Autostore** on the **Cycles** menu is active (ON):

Figure 47: Parameters for the RS232 interface

→ Remote access Remote access can be turned ON or OFF using a terminal program for remote control for F²C communication. Not operational in the measurement mode.

→ Device address You may enter a device address between 1 and 127.

Transfer parameters The values shown in the above illustration have been preset upon delivery of the device. You have to change the transfer parameters according to your interface.

6.8.10 Power Supply

The following settings can be performed:

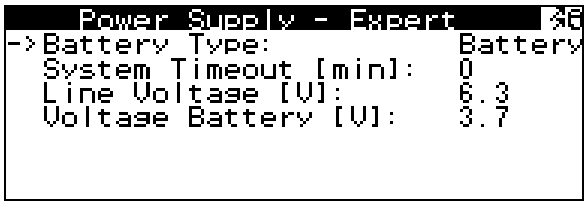


Figure 48: Menu item hardware with options

→ Battery Type Battery/ Accu

Here you can choose whether the LB 124 Scint is to be run with rechargeable batteries or batteries. If **Accu** is preset, the parameters **Charge mode** and **Charge time** appear in addition.

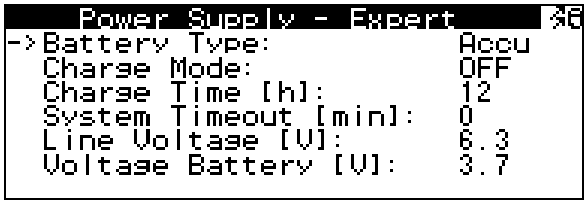


Figure 49: Selection of battery type and charge mode

Note:
If the device is placed into the wall holder or if it is turned on, the rechargeable batteries inside the device can be charged automatically, provided the **Charge mode** is set to ON. Via the menu item **Charge time** the duration of the charging process is limited to max. 12 hours to prevent overcharging. If you take out the device from the wall holder and place it into the wall holder again later, or if you turn the device off and on again, then the charging process will be re-started, provided the Charge mode is enabled.
Caution: The charge function is active only if the device has been turned on.

→ **Charge Mode** Here you can set the charge mode (ON/OFF). Only with setting **Accu**.

→ **Charge time** Here you set the duration of the charging process. Only with setting **Accu**.

→ **Line Voltage** Here the current line voltage is indicated. This value is determined and displayed by the device.

→ **Voltage Battery** Here the current battery voltage (or accu voltage) is indicated. Please take into account that the battery voltage indication is not relevant as long as the mains voltage is being supplied, as the battery is not in use during this time.

→ **System Timeout** Here an automatic switch-off function for the LB 124 Scint can be activated. When this function is activated, the device is automatically switched off when it is not operated for a predefined period of time, i.e. when no key is pressed. The default setting is 0 (function disabled).
This function is not enabled during a charging process!

6.8.11 Hardware

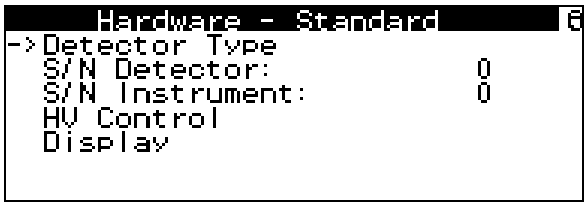


Figure 50: Hardware settings

These displays are not relevant for the user.

6.9 Profile

6.9.1 Overview

The access rights for different user (groups) can be defined on this menu. For each user, only the menu items will appear which he is allowed to work with (read and/or edit). At most 4 profiles are possible. Three are already predefined and can be modified.

EASY Only measurements are possible: gross, cps, ratemeter

STANDARD Here you can choose the menu items which are important for standard situations: All nuclides can be chosen, the small nuclide library is preset with gross, net and Co-60, the calibration factors however cannot be edited. As measurement mode, you can select ratemeter, scaler-timer and survey.

EXPERT All possibilities are given, the parameters can be edited (incl. the calibration factors).

Status after initial start-up

After the initial start-up, the device switches to the ratemeter mode and the STANDARD profile.
In this profile, only simple measuring tasks are accessible ratemeter or background measurement modes, nuclide selection from **Net** or **ß-Tot**, as well as switching between the languages. Under the profile menu item you can switch to the profile **EXPERT**. In this profile, all functions are accessible (see section 6.6.1).

The name of the currently selected profile is indicated in the top line of the display.

When the device is switched on, it loads the measurement mode predefined in the **Profile** menu (the factory-setting is the standard profile). The profile that was active when the device was last switched off will be automatically loaded.
The user can select a different profile, if he knows the appropriate PIN number required.

6.9.2 Editing Profiles

Profiles can be modified only by a user having **the** appropriate **PIN number**. The access rights (read/edit/no authorization) can be defined for each individual menu item.
When setting the profiles the following symbols are used:
R = authorization to read
W = authorization to edit
‚_‘ = no authorization
X = cannot be modified

Editing Profiles

- ❑ Select the **Profile** menu.

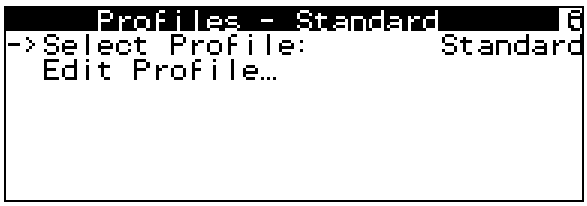


*Figure 51: **Profiles** menu*

- ❑ Select the profile you want to edit.
- ❑ Then choose **Edit Profile** and enter the requested PIN number after the following prompt:

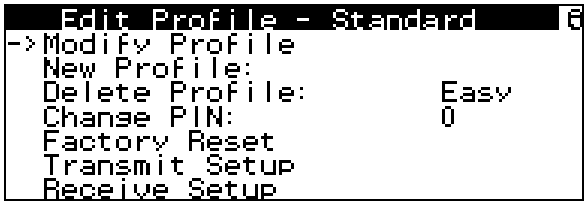


*Figure 52: **Edit Profile** menu*

- ❑ Select **Modify Profile** on the **Edit Profile** menu. The system then switches to the editing mode and goes to the **System** menu (see Figure 38). The profile you want to define an authorization for is displayed in the top line, along with the name of the menu you are in. The softkeys are displayed in the bottom line. On the **Edit Profile** menu the modifying mode is marked by an „X“ in front of every line, as in this menu no rights can be defined. In all other menus the defined authorization status (W/R/‚_‘) is displayed in front of every menu item. You can move as usual inside the menus.

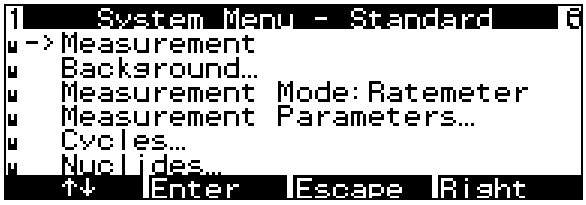


Figure 53: System menu

- On the **System Menu**, mark the menu item whose authorization status you want to change with the cursor (→).

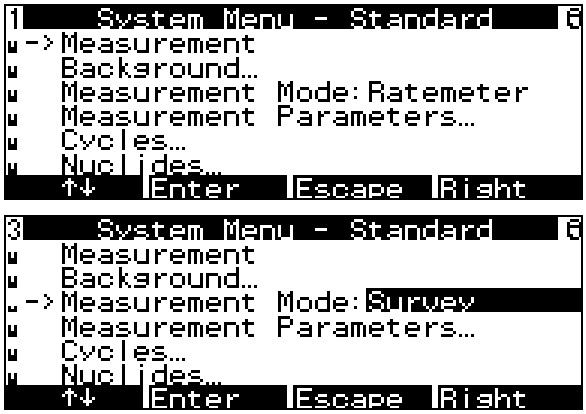


Figure 54: System menu – allocating rights

- Select the desired authorization status by pressing  repeatedly.
- This way you can set all access rights of the individual menu items for the profile concerned.
- *Please note* with menu item **measurement mode**: you can also set the access rights for the individual measurement modes: you have to move the cursor (→) to the menu item **measurement mode** and press the 

key. Now the rights settings are valid only for the selected measurement mode (and not for the whole menu item). By pressing the 

key once more, you switch back to the system menu.

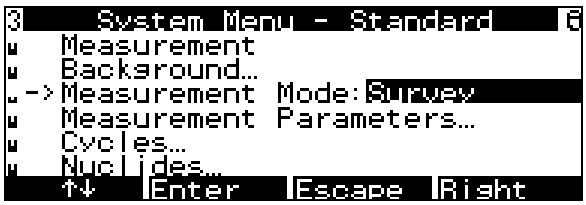


Figure 55: System Menu/Measurement mode: Survey

- To quit the **profile editing mode**, select the **Profile** menu once more and there the item **Edit Profile**. You will get to the **Profile | Edit Profile** menu. Select **Modify Profile** and push the ENTER button. The device switches from the modifying mode to the normal working mode. The device automatically jumps to the **System Menu**. The illustrations below show a reduced **System Menu** in which only those menus are displayed for which reading and/or editing rights have been assigned.

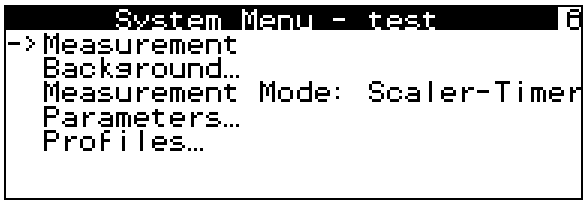


*Figure 56: Rights allocation for **test** profile*

- In order to switch back to the EXPERT profile, select the menu **Profiles** and set the EXPERT profile in **Select Profile**.

6.9.3 Preset Profiles

The profiles EASY, STANDARD and EXPERT are already predefined by the manufacturer and provided with the most useful parameters. The default settings for these three profiles can be found in the appendix.

6.9.4 Factory Settings

Here all settings can be reset to the factory-set values. This function deletes all profile settings defined by the user.

6.9.5 Transmit/Receive Setup

This function allows you to transmit all device settings to another LB 124 Scint device with the same software version number. An error message appears if both devices have different version numbers and the transmission cannot be started.
The transmission is protected in various ways.
Please keep in mind that in case of failed transmission the measured values will be lost on the receiving device. Therefore, do not interrupt data transmission!

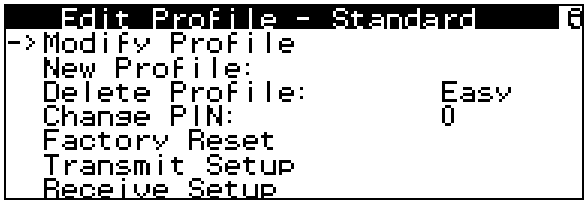


Figure 57: Transmit/Receive Setup

Proceed as follows

- ❑ Connect both LB124 Scint devices via a regular null modem cable (RS232 interface).
- ❑ Turn both devices on.
- ❑ At the receiving device, select the menu item **Profile/Edit Profile** and then **Receive Setup**.
- ❑ At the transmitting device, select the menu item **Profile/Edit Profile** and then **Transmit Setup**.
- ❑ Data transmission starts as soon as you have confirmed a safety dialog. During this time the LED is flashing on both devices.
- ❑ Successful data transmission is indicated by a corresponding message on the display.

7. Maintenance

7.1 Cleaning the Detector Window

The window foil of the detector is susceptible to mechanical damage. Therefore, it is protected by a relatively tight cover and protection grid. Nevertheless, you should avoid everything that could destroy the window foil (pointed objects, measuring stubble-fields, rose-hedges or cat's paws!).

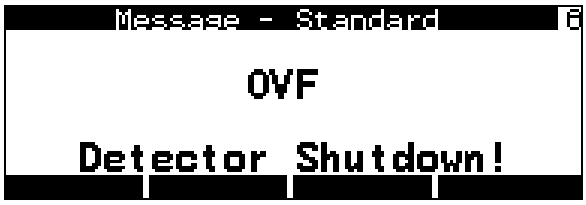
To protect the detector against soiling and radioactive contamination, it is advisable to protect the detector window, during field measurements, by gluing on a very thin protective foil (because of alpha radiation). If only beta and gamma radiation is measured, this foil may be a bit thicker (transparent household foil).

For **easy cleaning** of a dirty window foil, you can take off the outer protective grid after cautiously loosening the Phillips screws.

Cautiously clean the detector window foil with a smooth brush (dust) or with an alcohol or detergent solution (washing-up liquid). Then dry it using a hair-dryer that must not be too hot. When you re-insert the protective grid, please be careful not to damage the foil with the screws or the screwdriver!

7.2 Changing the Window Foil with Scintillator

A damaged detector window foil can easily be replaced by the user. BERTHOLD TECHNOLOGIES supplies a foil stretched over a frame as spare part.



Procedure

- **Change the foil in a darkened room (semi-darkness), as the photomultiplier and the scintillator will be exposed to light in the course of this process.**
- Turn device off and, if necessary, pull the power cord.
- Place the device with the detector facing up onto a solid, clean support.
- Open the 4 Philips screws holding the protective grid.
- Take off the protective grid.
- Take out frame with the foil.
- Insert the new frame with the foil such that the sealing lip sits perfectly to rule out any incidence of light.
- Attach protective grid again and fix it with the 4 Philips screws.
- **Do not start working with the device before 12 hours have elapsed to allow the phosphorescence radiation to decay.**

7.3 Exchanging the Battery

The device needs three dry batteries, type C, baby (IEC LR 14, with 1.5 volt each). The serviceable life of a fresh set of high output cells is more than 50 hours of continuous operation (without lighting and without RS232 communication). When the device is delivered, a set of reserve batteries is provided in addition to the batteries in the device.

The batteries are located on the back of the monitor in the battery case, which is covered with a cover plate. The fixing screw can easily be unscrewed with the help of a coin. The batteries are replaced as described on page 11 of this manual. After the replacement, secure the batteries with the cover plate.

If the device is run with almost dead batteries, it will be switched off automatically, as soon as the battery voltage is not sufficient for correct operation any more. In this case, the device cannot be restarted without exchanging the batteries.

Remove the batteries from the device when it is not used for a rather long period of time, e.g. several months.

7.4 Charging the Rechargeable Batteries

Only Ni-MH rechargeable batteries may be used in the LB 124. „**Accu**“ has to be set as cell type on the **Utility/Hardware** menu.
To charge the rechargeable batteries, connect the basic device to the mains supply (the device will be turned on automatically) and start the charging process on the menu **Parameter/Power Supply/Charge Mode**. This starts the charging process. In the meantime, measurements can be taken as usual, as the device works with mains voltage in this operating mode.

The charge function is active only if the device has been turned on. The charge process is finished when the time defined under ***Charge time*** *is over.*

Warning:
If there are batteries in the battery case instead of rechargeable batteries when the “Accu“ mode is selected and the charging process is started, this may cause an overheating of the batteries and thus damage the device.

8. Basis of Calculation

8.1 Count Rate Calculation

The LB 124 Scint updates the calculation of the raw data in CPS (counts per second) every second, i.e. the succeeding calculations are based upon intervals of 1 second.

General Formulas and Designations

t Measured time [s]

T_I Length of one interval (always 1s)

n_i Counting pulses of the current interval

$R = \frac{n_i}{T_I}$ Count rate (raw data)

R_b Gross count rate (mean raw data)

$R_{b_{-1}}$ Gross count rate of the preceding interval

R_n Net count rate

R_0 Background count rate

$W = \frac{1}{\tau}$ Weighting factor (depend. on the measurement mode)

	Formula	abs. error	rel. error
Gross count rate	$R_b = W * R + (1-W) * R_{b_{-1}}$	$\Delta R_b = \sqrt{\frac{R}{2\tau - 1}}$	$\frac{\Delta R_b}{R_b}$
Net count rate	$R_n = (R_b - R_0) * K$	$\Delta R_n = K * \sqrt{\Delta R_0^{\,2} + \Delta R_b^{\,2}}$	$\frac{\Delta R_n}{R_n}$

n Integral of counts

$R_{b,\min}$ Minimum gross count rate

$R_{b,\max}$ Maximum gross count rate

For the averaging of the measured values, a moving average is obtained using the formula:

$R_b = W * R + (1-W) * R_{b_{-1}}$

The weighting factor W is determined as follows in the rateme-ter function:

$$W = \frac{1}{\tau}$$

with τ = the number of seconds since the start of averaging.
The number of seconds used for the averaging depends on the measurement mode and can therefore determine whether a high accuracy with slower reaction time to changes is obtained, or a faster adaptation to changes involving a lower accuracy.
If the count rate changes significantly with respect to statistics within a short period of time, n will be reset to 1, so that the new measured values will then be weighted more.
The reject criterion can be individually set in each measurement mode. For this purpose, the standard deviation $\sigma = \sqrt{n}$ is used as a measure for the statistical significance. If the difference be-tween the current measured value and the current mean value is greater than a definable number of standard deviations, the averaging will be restarted and t will be reset to 1.

8.2 Ratemeter Function

The weighting factor W described in chapter 8.1 can either be determined in dependence on the time or the accuracy:
a) Preset time:
The number of seconds entered indicates the maximum period of time for which an average is obtained, i.e. given a preset time constant of 100, the weighting factor is calculated with W=1/100 after 100 s. The accuracy that can be reached in this case therefore depends on the count rate.
b) Preset accuracy:

When a relative accuracy of $\varepsilon = 1/\sqrt{n}$ in percent is reached, the current number of seconds since the start of the averaging is put in for n. The preset accuracy is recommended for higher count rates (from 100 cps on).

The reject criterion is preset to 4 σ; this means that whenever the difference between the current measured value per second and the mean value obtained with respect to the last measuring interval is greater than four times the standard deviation, n will be reset to 1 and the averaging interval will be restarted.

Basis of Calculation Ratemeter

:

Preset time: $W = \frac{1}{t}$ for $t < T_c$

$W = \frac{1}{T_c}$ for $t \geq T_c$

Preset accuracy: $W = \frac{1}{t}$ for $\frac{\Delta R_b}{R_b} \geq P$

$W = \frac{1}{P}$ for $\frac{\Delta R_b}{R_b} < P$

Reset and calculate W, t and ΔR_b new, if $|R - R_b| > S * \sqrt{R_b}$

	Designation	Variable	Unit	Default
Parameter	Averaging (Preset: time, accuracy)			Time
	Time constant (preset time)	T_c	[s]	100
	Accuracy (preset accuracy)	P	[%]	3.0
	Sigma factor	S		4.0
	Nuclide (with calibration factor K)	K		Net

8.3 Survey Mode

In the Survey mode, the same calculation algorithms are used as in the Ratemeter mode to calculate the average values. 3.5 σ has been preset as rejection criterion. The time constant for averaging is 20 s. Thus, the display responds quicker to changes in the count rate as compared to the Ratemeter mode.

Basis of calculation:

Preset time: $W = \frac{1}{t}$ for $t < T_c$

$W = \frac{1}{T_c}$ for $t \geq T_c$

Reset and calculate W, t and ΔR_b new, if $|R - R_b| > S * \sqrt{R_b}$

	Designation	Variable	Unit	Default
Parameter	Time constant (preset time)	T_c	[s]	20
	Sigma factor	S		3.5
	Nuclide (with calibration factor K)	K		Net

8.4 Half-life Measurement

At the start of the measurement, the count rate is average as in the Ratemeter mode.
The determination of the half-life period is started once the accuracy has been reached. Then a measurement takes place in the Scaler/Timer mode according to the formula:

$$T_{1/2} = \ln 2 * \frac{\ln R_{b_0} - \ln R_{b_x}}{T_x - T_0}$$

	Designation	Variable	Unit	Default
Parameter	Preset Time	T	[s]	1000
	Accuracy (Preset accuracy)	P	[%]	3,0
	Rate	T_c	[s]	30

Basis of calculation of half-life period:

Weighing:

$$W = \frac{1}{t} \text{ for } \frac{\Delta R_b}{R_b} > P$$

$$W = \frac{1}{T_c} \text{ otherwise}$$

T_0 Time of reaching the preset measurement accuracy

$$T_0 = \frac{1}{2} * t$$

R_{b_0} Gross rate upon reaching the measurement accuracy, $R_{b_0} = R_n$.

R_{b_x} Gross rate after reaching the measurement accuracy , $R_{b_x} = R_n$ at the time $T_x = T_0$.

8.5 Scaler-Timer Function

In the scaler-timer mode, all measured values within a set time interval are put together in an arithmetical mean.

There are three stop criteria for the time interval:

a) Time: Here the measurement runs until the preset period of time in seconds is over.
b) b) Counts: The measurement runs until the preset total number of counts is reached.
c) Precision: Here the criterion for the end of the measurement is given in the form of the relative precision reached in %. ($\varepsilon = 100 * 1/\sqrt{n}$)

The preset values (time: 120 s, counts: 1000 s, precision: 3.0%) have to be adapted according to the requirements of the measurement.

8.6 Bq-Calculation and Determination of the Calibration Factors

The explanation of the basic principles of the Becquerel calculation is not only of a documentary nature, but is meant to enable you to determine calibration factors for contamination measurements for further nuclides, which are not part of the nuclide library of the LB 124 Scint. For this purpose, the two free entry positions **B1** and **B2** are provided (see chapter 6).

To be able to convert counts per second into decays per second per cm_2, the constant K has to be determined according to the formula

$$\mathbf{Bq/cm^2 = K \times cps}$$

for each nuclide and for each type of detector.

Bq/cm_2 = area activity
K = conversion constant Bq x s per cm_2
Cps = counts per second measured

For the determination of K, a calibrating source with known activity per cm_2 is used (standardized to 100 cm_2) and measured with the LB 124 Scint. The result of this measurement is converted into Bq/cm^2 using the formula

$$K = \frac{A_{Test}}{cps}$$

converted in Bq/cm^2.

A_{Test} = test radiation source activity in Bq/cm^2, or double surface emission rate

Calibration source requirements

For the calibration for beta radiation measurements, sources meeting the requirements of the international standard ISO No. 8769 "Reference Sources for Calibration of Surface Contamination Monitors" are to be used. This standard prescribes that the measured value has to be applied to the surface emission rate, i.e. beta particles per second and per cm_2 being emitted from the test source surface. The activity of the source in relation to the surface in Bq/cm_2 then amounts to twice double of the surface emission rate in $s_{-1} \cdot cm_{-2}$.

Procedure

1. Choose the CPS measurement mode.

2. Place the hand-held probe upon the calibrating source in such a manner that it covers the source well, in order to loose as little activity as possible.

3. Measure the calibrating source for a measuring period of at least 10 seconds (in compliance with the table dealing with statistical measuring accuracy on page 7-3).

4. Calculate the constant K using the formula given above.

5. Enter the determined calibration factor in one of the free entry positions B1 or B2

The included test sources cannot serve as calibrating sources. They are point sources and can therefore not be used for the calculation of surface activities.

List of radionuclides with calibration factors programmed in the LB 124 Scint for conversion from cps to Bq/cm^2. Test sources have been used for the standardized area 10 cm x 10 cm (A-100). The factors according to ISO 7503-1 have been determined in accordance with the specifications of the standard.

LB124 SCINT SW Version 3.18			German Limit[1]	Efficiency, Response, Calibration Factors and MDAs ISO 7503-1[3]				
Nuclide	CH	eff_{src}	in Bq/cm²	Efficiency in %	Response in $s^{-1}Bq^{-1}cm^2$	Calibration Factor in s Bq cm^{-2}	Decision Thres. in Bq/cm²	Min. Det. Activity in Bq/cm²
Beta	b-g	0,50		70,0	59,50	0,017	0,018	0,036
C-11	b-g	0,50	1	74,1	63,00	0,016	0,017	0,034
N-13	b-g	0,50	1	74,7	63,53	0,016	0,017	0,034
C-14	b-g	0,25	100	28,6	12,16	0,082	0,085	0,173
O-15	b-g	0,50	1	74,9	63,66	0,016	0,017	0,034
F-18	b-g	0,50	1	87,4	74,28	0,013	0,013	0,028
Na-22	b-g	0,50	1	67,1	57,03	0,018	0,019	0,038
P-32	b-g	0,50	100	68,8	58,46	0,017	0,018	0,036
P-33	b-g	0,25	100	59,9	25,47	0,039	0,040	0,082
S-35	b-g	0,25	100	25,9	11,00	0,091	0,094	0,192
Cl-36	b-g	0,50	100	68,7	58,40	0,017	0,018	0,036
K-40	b-g	0,50	10	74,7	63,53	0,016	0,017	0,034
K-42	b-g	0,50	10	74,9	63,66	0,016	0,017	0,034
Ca-45	b-g	0,25	100	38,1	16,18	0,062	0,064	0,131
Sc-46	b-g	0,25	1	53,8	22,88	0,044	0,045	0,093
Ca-47+	b-g	0,50	1	6,2	5,31	0,189	0,195	0,400
Cr-51	b-g	0,50	100	0,05	0,05	22,2	22,9	47,0
Mn-54	b-g	0,50	1	1,60	1,36	0,734	0,756	1,552
Fe-55	b-g	0,50	100	0,08	0,07	15,2	15,6	32,0
Co-57	b-g	0,50	10	7,28	6,19	0,162	0,167	0,343
Co-58	b-g	0,50	1	16,8	14,31	0,070	0,072	0,148
Fe-59	b-g	0,50	1	68,4	58,17	0,017	0,018	0,036
Co-60	b-g	0,25	1	58,2	24,72	0,040	0,041	0,085
Ni-63	b-g	0,25	100	0,65	0,27	3,650	3,760	7,716
Ga-67	b-g	0,50	100	24,2	20,53	0,049	0,051	0,104
Se-75	b-g	0,50	10	10,5	8,90	0,112	0,115	0,237
Sr-85	b-g	0,50	1	3,12	2,65	0,377	0,388	0,797
Rb-86	b-g	0,50	10	74,9	63,66	0,016	0,017	0,034
Sr-89	b-g	0,50	100	66,7	56,70	0,018	0,019	0,038
Sr-90+	b-g	0,50	1	67,7	57,56	0,017	0,018	0,036
Y-90	b-g	0,50	100	65,0	55,25	0,018	0,019	0,038
Tc-99m	b-g	0,50	10	15,7	13,37	0,075	0,077	0,159
Tc-99	b-g	0,25	100	61,9	26,30	0,038	0,039	0,080
Ru-106+	b-g	0,50	10	74,9	63,66	0,016	0,017	0,034
In-111	b-g	0,50	10	26,0	22,10	0,045	0,046	0,095
Sn-113+	b-g	0,50	10	46,7	39,72	0,025	0,026	0,053
I-123	b-g	0,50	10	29,3	24,95	0,040	0,041	0,085
I-125	b-g	0,25	10	16,5	7,01	0,143	0,147	0,302
I-131	b-g	0,50	10	74,4	63,24	0,016	0,017	0,034
Cs-137+	b-g	0,50	1	70,6	60,01	0,017	0,018	0,036

Pm-147	b-g	0,25	1	28,9	12,27	0,082	0,085	0,173
Sm-153	b-g	0,50	10	84,8	72,06	0,014	0,014	0,030
Er-169	b-g	0,25	100	61,4	26,11	0,038	0,039	0,080
Re-186	b-g	0,50	1	68,1	57,88	0,017	0,018	0,036
Re-188	b-g	0,50	10	75,6	64,24	0,016	0,017	0,034
Au-198	b-g	0,50	10	74,1	63,00	0,016	0,017	0,034
Tl-201	b-g	0,50	10	2,78	2,36	0,423	0,436	0,894
Tl-204	b-g	0,50	100	65,8	55,94	0,018	0,019	0,038
U-238sec	b-g	0,25	1	107,3	45,61	0,022	0,023	0,047
Pu-238	b-g	0,25	0,1	7,8	3,31	0,302	0,311	0,638
Am-241	b-g	0,25	0,1	11,8	5,01	0,200	0,206	0,423
Po-210	a	0,25	1	42,3	17,99	0,056	0,058	0,118
U-238sec	a	0,25	1	62,0	26,34	0,038	0,039	0,080
Pu-238	a	0,25	0,1	44,5	18,92	0,053	0,055	0,112
Pu-239	a	0,25	0,1	35,9	15,25	0,066	0,068	0,140
Am-241	a	0,25	0,1	43,6	18,51	0,054	0,056	0,114
Alpha	a	0,25		40,0	17,00	0,059	0,061	0,125

1) Limits are from German Radiation Protection Ordinance 2001 Attachment III Table 1 Column 4
3) Reference to surface emission rates and 170 cm² sensitive detection area
4) Minimum detectable activities (MDAs) and decision thresholds were calculated according to DIN 25482-1 respectively ISO 11929-1 with measuring time 200 s for background and 30 s for sample
5) Background rates of 0.1 cps for alpha- and 10 cps for beta-gamma measurements.
6) From LB 124 SCINT Software Version 3.18

LB124 SCINT SW Version 3.18			**German Limit[1)]**	**Efficiency, Response, Calibration Factors and MDAs**				
				A-100[2)]				
Nuclide	**CH**	**eff_{src}**	**in Bq/cm²**	**Efficiency in %**	**Response in $s^{-1}Bq^{-1}cm^2$**	**Calibration Factor in s Bq cm^{-2}**	**Decision Thres. in Bq/cm²**	**Min. Det. Activity in Bq/cm²**
Beta	b-g	0,50		35,0	35,00	0,029	0,030	0,061
C-11	b-g	0,50	1	37,8	37,77	0,027	0,027	0,056
N-13	b-g	0,50	1	74,7	74,74	0,013	0,014	0,028
C-14	b-g	0,25	100	10,9	10,89	0,092	0,095	0,194
O-15	b-g	0,50	1	38,2	38,17	0,026	0,027	0,055
F-18	b-g	0,50	1	43,7	43,70	0,023	0,024	0,048
Na-22	b-g	0,50	1	34,2	34,19	0,029	0,030	0,062
P-32	b-g	0,50	100	42,9	42,86	0,023	0,024	0,049
P-33	b-g	0,25	100	26,1	26,06	0,038	0,040	0,081
S-35	b-g	0,25	100	11,2	11,22	0,089	0,092	0,188
Cl-36	b-g	0,50	100	43,5	43,51	0,023	0,024	0,049
K-40	b-g	0,50	10	38,1	38,09	0,026	0,027	0,056
K-42	b-g	0,50	10	38,2	38,17	0,026	0,027	0,055
Ca-45	b-g	0,25	100	19,4	19,40	0,052	0,053	0,109
Sc-46	b-g	0,25	1	27,4	27,43	0,037	0,038	0,077
Ca-47+	b-g	0,50	1	3,18	3,18	0,314	0,324	0,665
Cr-51	b-g	0,50	100	0,03	0,03	36,364	37,5	76,9
Mn-54	b-g	0,50	1	0,80	0,80	1,250	1,288	2,643
Fe-55	b-g	0,50	100	0,04	0,04	26,667	27,5	56,4
Co-57	b-g	0,50	10	3,64	3,64	0,275	0,283	0,581
Co-58	b-g	0,50	1	8,4	8,42	0,119	0,122	0,251
Fe-59	b-g	0,50	1	34,2	34,22	0,029	0,030	0,062
Co-60	b-g	0,25	1	28,9	28,86	0,035	0,036	0,073
Ni-63	b-g	0,25	100	0,32	0,32	3,125	3,219	6,606

Ga-67	b-g	0,50	100	12,1	12,08	0,083	0,085	0,175
Se-75	b-g	0,50	10	5,2	5,23	0,191	0,197	0,404
Sr-85	b-g	0,50	1	1,59	1,59	0,629	0,648	1,330
Rb-86	b-g	0,50	10	38,2	38,17	0,026	0,027	0,055
Sr-89	b-g	0,50	100	41,9	41,92	0,024	0,025	0,051
Sr-90+	b-g	0,50	1	84,3	84,33	0,012	0,012	0,025
Y-90	b-g	0,50	100	41,0	41,05	0,024	0,025	0,052
Tc-99m	b-g	0,50	10	7,9	7,86	0,127	0,131	0,269
Tc-99	b-g	0,25	100	30,5	30,50	0,033	0,034	0,069
Ru-106+	b-g	0,50	10	38,2	38,17	0,026	0,027	0,055
In-111	b-g	0,50	10	13,0	13,00	0,077	0,079	0,163
Sn-113+	b-g	0,50	10	23,4	23,37	0,043	0,044	0,091
I-123	b-g	0,50	10	14,7	14,67	0,068	0,070	0,144
I-125	b-g	0,25	10	8,2	8,25	0,121	0,125	0,256
I-131	b-g	0,50	10	42,6	42,58	0,024	0,024	0,050
Cs-137+	b-g	0,50	1	43,1	43,15	0,023	0,024	0,049
Pm-147	b-g	0,25	1	14,7	14,71	0,068	0,070	0,144
Sm-153	b-g	0,50	10	59,5	59,51	0,017	0,017	0,036
Er-169	b-g	0,25	100	31,4	31,40	0,032	0,033	0,067
Re-186	b-g	0,50	1	42,0	42,04	0,024	0,025	0,050
Re-188	b-g	0,50	10	101,1	101,11	0,010	0,010	0,021
Au-198	b-g	0,50	10	37,8	37,77	0,027	0,027	0,056
Tl-201	b-g	0,50	10	1,39	1,39	0,719	0,741	1,521
Tl-204	b-g	0,50	100	37,2	37,15	0,027	0,028	0,057
U-238sec	b-g	0,25	1	48,1	48,12	0,021	0,021	0,044
Pu-238	b-g	0,25	0,1	3,6	3,63	0,276	0,284	0,583
Am-241	b-g	0,25	0,1	5,6	5,57	0,180	0,185	0,380
Po-210	a	0,25	1	21,6	21,60	0,046	0,048	0,098
U-238sec	a	0,25	1	27,8	27,79	0,036	0,037	0,076
Pu-238	a	0,25	0,1	20,7	20,68	0,048	0,050	0,102
Pu-239	a	0,25	0,1	18,3	18,29	0,055	0,056	0,116
Am-241	a	0,25	0,1	20,6	20,58	0,049	0,050	0,103
Alpha	a	0,25		20,0	20,00	0,050	0,052	0,106

1) Limits are from German Radiation Protection Ordinance 2001 Attachment III Table 1 Column 4
2) Reference to activities and 100 cm² source area
4) Minimum detectable activities (MDAs) and decision thresholds were calculated according to DIN 25482-1 respectively ISO 11929-1 with measuring time 200 s for background and 30 s for sample
5) Background rates of 0.1 cps for alpha- and 10 cps for beta-gamma measurements.
6) From LB 124 SCINT Software Version 3.18

9. Technical Data

Application	Radiation monitor for measuring radioactive contaminations with alpha, beta and gamma sources on surfaces.
Display	Monochrome LCD graphics module with 192x64 pixels, LED backlighting, extended temperature range.
Keyboard	Foil keyboard, 6 tactile response keys, 4 softkeys, 1x device on/off, 1x tone/LCD-lighting on/off 2 LED's for alert signal and functional check
Detector	ZnS:Ag scintillation detector
Dimensions	External: 143 mm x 168 mm
Sensitive detector area	118 mm x 145 mm
Entrance window	Layer thickness: 6 µm Weight per unit area: 0,8 mg/cm²
Geometrical transmission	80%
Background	Alpha channel: 0.1 cps Beta channel: 12 cps
Sensitivity to 1 µSv/h external gamma radiation (Cs137)	Alpha channel: not detectable Beta channel: < 100 cps
Spillover	Alpha into beta channel (Po210): < 20% Beta into alpha channel (Sr90): $< 2*10^{-5}$
Measuring range (deflection linearity error < ±10%)	Alpha channel: 0 – 5 000 cps Beta channel: 0 – 50 000 cps (for Alpha channel < 750 cps)
Local variation **Responsiveness**	Both channels: ±20%

Temperature range	Temperature range operation: -20°C ... +40°C (no condensation) Stability over range: ±10% Temperature range storage: -40°C ... +60°C
Protection type	IP53
Overrange Indication	>50 000 cps
Light-proof/Entrance window	Sunlight <10 cps
External magnetic fields	Close to PC monitor no visible influences
Housing	Splash-proof if housing is in upright position. The membrane of the acoustic signal device is sealed; water penetrated into the space in front of it can be emptied by shaking. The battery case is sealed towards the interior containing the electronics. The battery case can be opened with a coin.
Battery supply	3 batteries type "C", baby or corresponding Ni-MH rechargeable batteries; the rechargeable batteries can be charged in the detector using a power supply unit with connector or a wall bracket.
Mains operation	Primary voltage: wide-range input 90-264VAC 50/60 Hz Output voltage: 6V, 1.5 A
Period of operation	With 3.5 Ah Ni-MH rechargeable batteries 25 h With 7.8 Ah Alkaline batteries 50 h
Input / Output	9-pin Sub-D-connector for RS232 connection (5 lines with hardware handshake) to PC or printer.
Measurement modes	Survey, Ratemeter, Scaler-Timer, Clearance measurement, Half-life value measurement
Nuclide list	Factory-set calibration factors for more than 50 nuclides (editable)
Data storage	The measured values can be stored and output via a serial interface. Approx. 1000 measured values with date and time
Further software properties	Software update via serial interface Language can be selected Different user profiles (access rights for functions / measurement modes and parameters can be defined) Threshold values can be set separately for each radio nuclide
Alarm	Acoustic: Piezo acoustic resonator 2.5-3 kHz alarm as interrupted permanent signal, Single pulse (can be switched on additionally) as tone burst approx. 4 ms Optional vibration alarm
Warnings	LED signals for exceeded threshold values and for functional displays Text messages on display for exceeded count rates and detector failure

10. Index